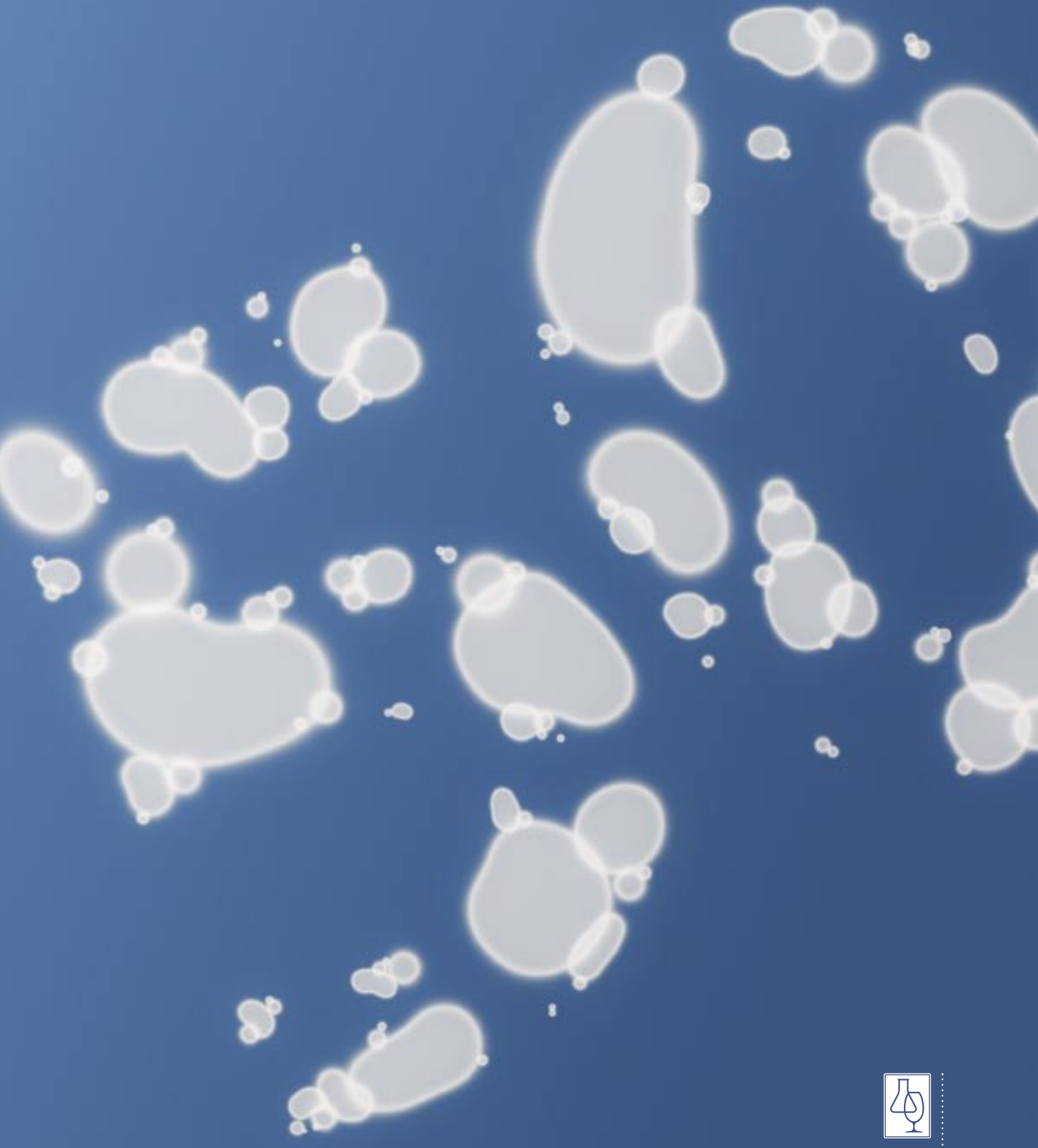
The Australian Wine Research Institute Annual Report 2005



Celebrating our 50th year

Council Members

Mr R.E. Day, BAgSc, BAppSc(Wine Science)
Chairman–Elected a member under Clause 6(e) of the Articles of Association

Mr J.F. Brayne, BAppSc(Wine Science)
Elected a member under Clause 6(e) of the Articles of Association

Mr P.J. Dawson, BSc, BAppSc(Wine Science)
Elected a member under Clause 6(e) of the Articles of Association

Mr P.F. Hayes, BSc, BAppSc(Wine Science), MSc, DipEd
Elected a member under Clause 6(e) of the Articles of Association

Professor P.B. Høj, MSc, PhD
Ex officio under Clause 6(d) of the Articles of Association as Managing Director of the AWRI (until 27 August 2004)

Mr T.W.B. James, AssDip(WineProd)
Elected a member under Clause 6(e) of the Articles of Association

Mr G.R. Linton, BAppSc(AppChem), GradDip(SysAnal)
Elected a member under Clause 6(e) of the Articles of Association

Professor I.S. Pretorius, BSc(Hons), MSc, PhD
Ex officio under Clause 6(d) of the Articles of Association as Managing Director of the AWRI (from 30 August 2004)

Associate Professor C.C. Steel, BSc(Hons), PhD
Charles Sturt University Representative under Clause 6(c) of the Articles of Association (from 27 October 2004)

Professor S.D. Tyerman, BSc(Hons), PhD
The University of Adelaide Representative under Clause 6(b) of the Articles of Association

Dr R.R. Walker, BAgSc(Hons) PhD
CSIRO Representative under Clause 6(a) of the Articles of Association

The Company

The Australian Wine Research Institute was incorporated under the South Australian Companies Act on 27 April 1955. It is a company limited by guarantee, it does not have a share capital and it has been permitted, under licence, to omit the word 'limited' from its registered name.

The Constitution of The Australian Wine Research Institute sets out in broad terms the aims of the Institute and the Report of the Committee of Review for the Institute published in March 1977 identified the following specific aims:

1. To carry out applied research in the field of oenology.

2. To service the extension needs of the winemakers of Australia.

3. To be involved in the teaching of oenology at both undergraduate and postgraduate levels.

4. To assume responsibility for the co-ordination of oenological activities, and the collection, collation and dissemination of information on oenological and viticultural research to the benefit of the Australian wine industry.

The AWRI's laboratories and offices are located within an internationally renown research cluster on the Waite Precinct at Urrbrae in the Adelaide foothills, on land leased from The University of Adelaide. The original lease is for a term of 99 years, with a right of renewal clause for a further 99 years. The AWRI formally affiliated with The University of Adelaide in 1990. The first buildings were erected and opened in 1957 and alterations and extensions were completed in 1976. The buildings have been extensively modified and refurbished since that time with major extensions being undertaken in 1994 and 1999. Plans are currently being considered for a new home for The Australian Wine Research Institute within the Wine Innovation Cluster on the Waite Precinct.

The AWRI is clustered with the following research and teaching organisations: Australian Centre for Plant Functional Genomics (APFG), Australian Genome Research Facility (AGFR), Australian Grain Technologies (AGT), Australian Wheat Management, BiometricsSA, three different Cooperative Research Centres (CRC), including the CRC for Viticulture, three divisions of CSIRO, Department of Water, Land and Biodiversity Conservation, Primary Industries and Resources South Australia (PIRSA), Provisor Pty Ltd, South Australian Research and Development Institute (SARDI) and The University of Adelaide's School of Science (which includes the Schools of Agriculture and Wine and Earth and Environmental Sciences).

Registered office

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Acknowledgements

Compiled and edited by Rae Blair

Design by Geoffrey Reed Communications

51st Annual Report
30 June 2005

Presented to
the Australian wine industry

Council Notes

Sakkie Pretorius (Managing Director)
Peter Dawson
Tim James
Robin Day (Chairman)
Peter Hayes
Geoff Linton
Jim Brayne
Chris Steel
Stephen Tyerman

Chairman
At the Council Meeting held on 24 November 2004, Mr R.E. Day was elected Chairman of Council.

Members of the Executive Committee
Mr R.E. Day
Professor P.B. Høj (until 27 August 2004)
Mr T.W.B. James
Mr G.R. Linton
Professor I.S. Pretorius (from 30 August 2004)
Professor S.D. Tyerman

Deputy Members of Council
Mr N.P. Blieschke
Mr L.P. Deans
Dr P.R. Dry
Dr A. Koltunow
Mr D.J. McWilliam
Mr A.N. Sas

Audit Sub-Committee
Mr R.E. Day
Mr P.J. Dawson
Mr T.W.B. James

Meetings
Ordinary General Meeting
The 50th Ordinary (Annual) General Meeting was held on 24 November 2004.

Council
The Council of the AWRI met on the following dates: 24 August 2004, 24 November 2004, 23 February 2005 and 24 May 2005. Executive members of Council met on 24 August 2004 and 9 December 2004.

Funding
The Council of the AWRI acknowledges the continuing financial support of the Grape and Wine Research and Development Corporation.

Appreciation
The AWRI acknowledges the assistance and cooperation of the following organisations throughout the year:

Australian Wine and Brandy Corporation

Charles Sturt University

Commonwealth Scientific and Industrial Research Organization (CSIRO)

Cooperative Research Centre for Viticulture

Department of Agriculture, Fisheries and Forestry

South Australian Wine Industry Association Inc.

State Departments of Agriculture

State Government of South Australia

The University of Adelaide

Winemakers' Federation of Australia Inc.

Chairman's report

On 23 June 1955 the first meeting of the AWRI council was held. It is unlikely that the first councillors, Messrs Hardy, Haselgrove, Lyon, Auld and Dr Forster would have had any idea of the magnitude of what they were starting. An initial budget of $20,700 and two research staff is a far cry from today's budget of $7 million and 84 staff.

As we celebrate our 50th year it is appropriate to remember that the achievements of the AWRI over its life are the integral sum of the efforts of approximately 200 staff and students. Together, they have produced over 850 publications on wine science and technology and given advice to viticulturists and winemakers through avenues and at venues which have been many and varied.

In characteristic fashion, our staff have chosen to celebrate the 50 years of the AWRI by redoubling their efforts to communicate the fruits of their labour to their constituency — the levy payers. A program of seminars has been mounted with presentations of the AWRI's activities, and the opportunity for our researchers to seek feedback on the wine industry's requirements. By year's end these seminars will have been presented in 17 regions around Australia with an estimated attendance of more than 600. A commemorative publication containing definitive review articles in the AWRI's key fields of endeavour will be published and distributed. These review articles have also been published in a special commemorative edition of the *Australian Journal of Grape and Wine Research* (Volume 11[2]); two papers will appear in the Journal's Volume 11(3); and one in the September/October 2005 issue of the *Australia and New Zealand Wine Industry Journal*. We gratefully acknowledge the assistance of the AJGWR in making it possible to celebrate our 50th year with another initiative to aid information dissemination of benefit to Australian winemakers and grapegrowers.

Of all the lessons learnt over the last decade, probably the single most compelling one is that collaboration across disciplines and institutions is the new way for effective research. Most simply put, the combined goal is more important than the process, the strategy and the collective egos of the participating partners. Our experiences through the CRCVs have encouraged us to broaden our reach to the point that today we collaborate with more than 30 universities, other institutions and companies throughout Australia and internationally (Appendix 1). These include institutions located in Stellenbosch, Giesenheim, Montpellier, Bordeaux, Santiago, Barcelona, Pamplona and Oregon.

As many levy payers will be aware, the rapid expansion of the AWRI's activities have left us constantly playing 'catch up' in relation to physical resources to facilitate our activities. Accordingly we have now embarked on our greatest collaborative journey to date — the construction of, and engagement of partners in, the *Wine Innovation Cluster*. The financial driving force behind this initiative has been the provision of funding of $9.5 million to the Cluster by the state government of South Australia for a new home for the AWRI. We gratefully acknowledge this visionary move by the SA government to support a truly national centre with the critical mass to deliver outcomes for an industry which is increasingly delivering to the economy. This concept delivers us a new home but, compared to the main game, the physical resources are of minor importance. As we experience the challenges of working with multiple partners to build the centre it is important to remind ourselves that the centre must be the catalyst for a fully engaged partnership of research providers producing outcomes for the benefit of the wine industry.

In parallel with the challenges of a large building initiative, the AWRI has recently revisited strategy issues and has produced a business plan to map the future directions. The AWRI of the future is likely to have its most powerful collaborations within the Wine Innovation Cluster where it will stand alongside its partners to provide the critical mass and the focus for cross-disciplinary research. It is envisaged that specialised regional collaborations within Australia and strategic international collaborations with first-class providers will provide the required balance. The outreach to the wine regions of Australia will be both in research and extension. Existing core strengths such as flavour chemistry and phenolic chemistry will be the foundation of research activities but further development of the biological science of wine alongside enhanced sensory capabilities specifically tuned to consumer preferences will complete the picture.

A small but important part of the business plan calls for sources of funding as yet untapped, but independent of industry levies, to be investigated to provide additional resources for 'frontier' research. This is the area in which some of the most productive results are generated, although because of the very uncertainty and serendipitous nature of the work, the attendant risk is higher. A brief case study of the current work in the area of volatile thiol flavour chemistry illustrates the point well. Our current knowledge in this field had its genesis several years ago with the chance redeployment of a PhD student into a different line of investigation. After some background surveying of capability of different yeast strains to alter these potent flavour compounds from their bound flavourless form to their highly flavoured form, the investigatory thread has broadened and deepened. Currently the volatile thiol work involves up to nine of our staff at any one time and in the future we anticipate vertically integrating this work right through the winemaking and viticultural chain as well as the consumer at the other end of the chain. From an intuitive beginning it is very likely that key ways of developing wine flavour will be understood and harnessed. Thus, a small amount of resources being put into 'frontier' research can generate the building blocks for important outcomes for the wine industry.

Early in the year our Chief Executive, Professor Peter Høj, moved to the ARC to run the research funding covering much of Australia's governement R&D expenditure. We wish Peter well in his new and very challenging job, knowing that he will take to it the same enthusiasm and professionalism which he applied to running the AWRI. Peter's contribution to the AWRI was outstanding in many ways and his efforts have us well placed to enter the next era. His position was taken by our Director of Research, Professor Sakkie Pretorious. Sakkie has stepped right into a high paced environment and has already proven himself to be a very able replacement, displaying a dedication to a very high work load and a subtlety to winkle out solutions to problems when they are not always apparent.

During this most challenging past year, our staff have taken on board the additional tasks of celebrating our 50th anniversary by putting substantially more effort into disseminating information. The stoical way that these extra responsibilities are taken on is a reflection on the positive attitude of all in the AWRI.

Similarly, staff involved in the planning process and council members have been required to put much more effort into understanding the nuances of a large building project and to comprehend the subtle differences in priorities as expressed by all the partners in the WIC project. In particular, our CEO, Professor Sakkie Pretorius has been on constant call to communicate the nature of the project accurately to parties many and varied.

Two things are certain. We should be grateful for the extra efforts of our staff and councillors, but the next two years will see our challenges rise to a different level again as we build and engage partners for the benefit of the industry. The mood amongst our staff is unmistakable — they are keen to face the challenges.

Robin Day
Chairman of Council

Managing Director's report

Sakkie Pretorius
(Managing Director)

Robin Day
(Chairman)

This year, The Australian Wine Research Institute celebrated its 50th Anniversary. It is a great pleasure to be the Managing Director of the AWRI during this special year. As a relative newcomer to the AWRI I still remember the excitement I felt when I visited the AWRI for the first time as an international visitor. The AWRI has such a strong international reputation for scientific excellence that I could not wait to visit and meet with the staff that had built that reputation. Now, as the Managing Director I feel an enormous pride to be part of this organisation and its 50 year history as well as that old excitement when I look ahead to see where the AWRI is traveling in the future.

Having taken over the position of Managing Director from the dynamic and visionary Peter Høj in August 2004, this is my first opportunity to write some words for the Annual Report and an appropriate time for me to acknowledge the enormous contribution Peter has made to wine science, the AWRI and the industry. It is also an appropriate time for me to briefly outline my own scientific vision for the AWRI. It is as true for the wine industry as for all science that one of the biggest challenges is to show value and benefit in what can be achieved when innovators look over the horizon and see a future that awaits the general public, and in particular the wine consumer. We are reminded constantly in our daily lives of the contributions of science and technology that were barely foreseen when the research was being done decades earlier. Many household goods we enjoy today are the fruits of technological research planted many years ago. This illustrates the importance of research and development (R&D) and how we at the AWRI view our role in seeking to bridge the gap between the pursuit of scientific excellence and the meeting of industry and consumer needs.

For just as the Stone Age did not end because man ran out of stones, the wine industry will, despite the abundance of traditional approaches to grapegrowing and winemaking, continue on a path of technological progress to which the AWRI will undoubtedly contribute enormously. As a research organisation, we recognise that we must strike an appropriate balance among strategic frontier science, applied science and the direct financial and productive benefits to the wine industry. In all aspects, we aim to innovate to generate an environment where our R&D can create a competitive advantage for able winemakers to apply existing and emerging knowledge. It can be argued that the current size of the Australian wine industry, its contribution to the economy, global influence and market share would be a shadow of itself but for the financial and human commitment to R&D in the past 50 years. Despite the clear benefits of technological progress, the environment in which we as wine scientists work is in a constant state of transition because the decreasing availability of public funds for fundamental research has made researchers more dependent on industry support.

Interaction between researchers and the wine industry is not new, but changing national priorities, globalisation, and shifting consumer preferences, as well as other economic, political and societal issues are making the relationship more complex. These issues pose formidable challenges for wine scientists to strive for academic excellence, and at the same time to deliver tangible commercial outcomes that can enhance the international competitiveness of the wine industry. However, it is important that, whatever the changes and new demands, they should not be allowed to erode the scientific base because wine research needs to be a careful blend of fundamental strategic and goal-orientated applied research.

On several occasions, I have stated my vision for the AWRI's research program at various public fora. I believe that high-impact outcomes from R&D programmes rely on basic strategic research to create new knowledge, which has been tested under applied conditions and translated into a commercial activity by the industry. In other words, fundamental wine

research cannot function at the opposite pole to applied research — the gap between fundamental science and applied science must be bridged so that industry application can be realised.

To achieve this, I believe that the approach needed should be an inclusive one where wine research at both the problem selection and experimental design levels is directed toward increasing fundamental understanding in a way that responds to the needs of those who will use it.

Targeted research and synergistic partnerships between industry practitioner and scientist become even more important. The metaphor for these partnerships, therefore, is not the relay race in which the baton is passed from the researcher to the practitioner. At the AWRI, we see ourselves more as players in a rugby team passing the ball back and forth, moving the full distance to the goal line as a unit with the practitioners. It is in this way that basic and applied wine research continually enlightens one another — and how the AWRI's world-class, cross-disciplinary research teams bridge the gap between science and commerce.

I strongly believe that wine research inspired by the quest for understanding of the scientific fundamentals and the promise of future commercial use, provides the most powerful dynamo of technological progress. This combination will achieve the production of wine with minimised resource inputs, improved product quality, increased health benefits and low environmental impact.

It is clear that this R&D approach is already firmly entrenched at the AWRI as evidenced by the scientific papers and industry articles published last year and papers, posters and workshops presented at the 12th Australian Wine Industry Technical Conference (AWITC) in Melbourne in 2004.

During the past year, the AWRI has undertaken a number of huge tasks. The biggest, without doubt, is the staging of the 12th AWITC. The staging of a conference the size of the 12th AWITC, places a great deal of pressure on all of the staff of the AWRI, not just those involved directly with the conference, but I am pleased to say that all staff members rose to the occasion admirably. AWRI staff members contributed, by way of presenting, convening or general support to 23 of the 67 workshops on offer at the conference, and prepared or contributed 67 of the 220 posters presented. I wish to acknowledge the hard work of Peter Godden, Narelle D'Costa and Ella Robinson in the coordination of the ambitious workshop program, and Randell Taylor for the coordination of the poster program. Rae Blair, Kate Beams and Sue Milnes were responsible for the management and secretariat of the AWITC. The staff members who were involved directly with the conference did an amazing job and I would like to thank them for all their efforts.

However, I would also like to thank the staff members who were not directly involved in the conference as their support made it possible for the conference to run smoothly. It was a team effort that so distinguishes AWRI staff, and of which the AWRI can be justifiably proud.

Having written about our R&D approach at the AWRI, it would be remiss of me at this point not to mention that the AWRI's projects are funded by the levies paid by Australia's winemakers and grapegrowers with matching funding from the Australian government. This funding is managed by the Grape and Wine Research and Development Corporation (GWRDC) and the AWRI receives approximately one-third of the GWRDC's total R&D budget. We are very grateful for their contribution and the supportive relationship we enjoy.

As 2005 draws to a close it is heartening to look back on a busy but rewarding and exciting year. The successful staging of the 12th AWITC; the 50th Anniversary year of the AWRI with its seminar program and other associated events; as well as a full year of our 'normal' research, problem-solving and extension activities means we reach the end of the year tired but well satisfied with our efforts. I would like to thank the hard working and dedicated staff members of the AWRI who really have made the AWRI the world renown organisation it is today. I would also like to thank the AWRI Councillors for their enthusiasm and thoughtful insights in helping to direct the AWRI into the future in the best possible shape. A special thanks goes to our Chairman, Robin Day, for his unflagging support not only of the AWRI but of me in my first year as Managing Director.

Already, the AWRI is looking forward to 2006 and anticipating another busy year. The AWRI is now involved in the planning stages of the Wine Innovation Cluster concept which will really start to gain momentum next year as the plans head toward completion. Together with our Council and staff, I look forward to facing the challenges of the new year.

Sakkie Pretorius
Managing Director

Staff

Peter Bordier Høj, MSc, PhD *UCopenhagen*, Managing Director (until 27 August 2004)

Isak Stephanus Pretorius, BSc(Agric)(Hons), MSc(Agric), PhD *Orange Free State*, Managing Director (from 30 August 2004)

Shiralee Joy Dodd, BA, LLB *UAdel.*, Personal Assistant to the Managing Director (from 18 October 2004)

Research

Markus Johannes Herderich, PhD *UWuerzberg*, Group Manager — Research

Heather Margaret Donnell, Secretary to the Group Manager — Research

Paul Joseph Chambers, BSc(Hons), PhD *Hertfordshire*, Principal Research Molecular Microbiologist (from 17 January 2005)

Paul Anthony Henschke, BSc(Hons), PhD *UAdel.*, Principal Research Microbiologist

Mark Aidan Sefton, BSc(Hons), PhD *UWA*, Principal Research Chemist

Elizabeth Joy Waters, BSc, PhD *UAdel.*, Principal Research Biochemist

Robert George Dambergs, BSc(Hons) *UAdel.*, PhD *UQld*, Senior Research Chemist

Ian Leigh Francis, BSc(Hons) *Monash*, PhD *UAdel.*, Senior Research Chemist

Yoji Hayasaka, DipEng(IndChem) *Tokyo I.T.*, MPharm *Vic. Col. Pharm.*, CertIntBusMgt *Monash*, Manager — Mass Spectrometry Facility

Eveline Jutta Charlotte Bartowsky, BSc(Hons), PhD *UAdel.*, Research Microbiologist

Daniel Cozzolino, AgricEng *Uruguay*, PhD *Aberdeen,* Research Chemist

Gordon Michael Elsey, BSc(Hons), PhD *Flinders*, Research Chemist

Alan Percy Pollnitz, BSc(Hons), PhD *UAdel.*, Research Chemist/Computer Systems Officer

George Kyriakos Skouroumounis, BSc(Hons) *Flinders*, PhD GradDipOenol. *UAdel.*, Research Chemist

Paul Alexander Smith, BSc(Hons), PhD *Flinders,* Research Chemist

Patrik Raymond Jones, BAgSc, PhD *UAdel.*, Research Chemist (concluded 11 February 2005)

Jan Hendrik Swiegers, MSc, PhD *Stellenbosch,* Research Molecular Biologist

David William Jeffery, BTech(For's & AnalytChem), BSc(Hons), PhD *Flinders*, Postdoctoral Research Fellow (commenced 21 March 2005)

Simon Anthony Schmidt, BSc(Hons), PhD *Flinders*, Postdoctoral Research Fellow (commenced 21 March 2005)

Heather Eunice Smyth, BSc(Hons), PhD *UAdel.,* Postdoctoral Research Fellow (concluded 21 January 2005)

Maria del Mar Vilanova de la Torre, PhD *Universidad de Santiago de Compostela,* Visiting Postdoctoral Fellow, Spain (from 17 January 2005 to 29 April 2005)

Kenneth Frank Pocock, BAppSc *UAdel.*, FAIFST, Senior Chemist

Dimitra Capone, BAppSc, AssDip(Chem) *USthAust.*, Chemist

Kate Alexandra Lattey, BSc *Canterbury,* Chemist/Sensory Analyst

Tangerine 'Mango' Parker, BSc *Flinders*, Chemist

Tracey Ellen Siebert, BSc *UAdel.*, Chemist

Steven van Sluyter, BA, BSc *UNthCarolina,* Visiting Scientist

Christopher Daniel Curtin, BSc(Hons) *Flinders,* Microbiologist

Cristian Andres Varela Cabrera, BBiochem, MBiochem, PhD *Catholic Uni Chile,* Microbiologist

Leslie Joseph Janik, AssDipIndChem *USthAust.,* MAppSc *USthAust.,* Technical Research Officer

Gayle Ann Baldock, BSc(Hons) *Guelph,* Technical Officer/Casual Analyst

Wieslawa Cynkar, BSc, PhD *Wroclaw,* Technical Officer

Helen Elizabeth Holt, BAgSc(Hons), PhD *LaTrobe,* Technical Officer

Maria Jolanta Kwiatkowski, MSc *Gliwice,* Technical Officer

Holger Gockowiak, BSc(Hons) *UAdel.*, Laboratory Manager

Kevin Herbert Pardon, AssDip(AppChem) *SAIT,* Laboratory Technician

Jennifer Rose Bellon, Technical Assistant

Belinda Ruth Bramley, Technical Assistant

Sally Anne Kollmann, BA, DipEd *UMelb,* CELTA Cert. *UCambridge,* Sensory Assistant (commenced 3 May 2005)

Jane Melissa McCarthy, AdCertMedLabSc *USthAust.,* CertVetNurs, CertAnimHand *TAFE,* Technical Assistant

Anne Morgan, PhD *UAdel.*, Casual Technical Assistant (commenced 11 January 2005)

Robyn Louise Willmott, BSc *USthAust.*, Hons *UAdel.*, Technical Assistant (commenced 15 November 2004)

Maria Josephine Birse, MSc *Nottingham,* BSc(Hons) *Brunel,* Postgraduate Student

Vincent Bouyer, ME *Université de Technologie Compiégne*, Visiting Postgraduate Student, France (from 13 September 2004 to 4 March 2005)

Antonio Felipe Garcia Cordente, BChem/Biochem *Barcelona,* Postgraduate Student

Agnieszka Cox, BSc(Hons) *Flinders,* Postgraduate Student

Merran Alida Daniel, BTech, BSc(Hons) *Flinders,* Postgraduate Student

Jennifer Gardner, BSc, *UAdel.,* Postgraduate Student

Antonio Grimaldi, MSc (equiv.) *Florence,* Postgraduate Student

Kate Susan Howell, BSc(Hons) *UNSW,* Postgraduate Student (completed March 2005)

Oenone Jean Macintyre, BSc, BE(Chem)(Hons), *UAdel.,* Postgraduate Student

Daniel Francois Malherbe, MSc, *Stellenbosch,* Visiting Postgraduate Student (from 23 August 2004 to 23 February 2005)

Ana Maria Molina, BBiochem *Pontificia U Catolica de Chile,* Visiting Postgraduate Student, Chile (from 4 April 2005)


Chris Curtin

Richard Anthony Muhlack, BE(Chem)(Hons), *UAdel.,* Postgraduate Student

Carolyn Jane Puglisi, BSc *Flinders,* BSc(Hons) *UAdel.,* Postgraduate Student

Tina Tran, BSc(Hons) *Victoria,* Postgraduate Student (from 25 January 2005)

Maurizio Ugliano, Visiting Postgraduate Student, Italy (from 28 July 2004 to 12 November 2004)

Kerry Leigh Wilkinson, BSc(Hons) *Flinders,* Postgraduate Student

Claudia Wood, Visiting Postgraduate Student, Chile (from 4 April 2005)

Rachel Christine Brown, BTech(For's & AnalytChem) *Flinders,* PhD Student

Matthew Carlyle Caldersmith, BSc(Hons) *UAdel.,* Honours Student

Jennifer Cartwright, BAgSc(Hons) *UAdel.,* Honours Student

Julia Stephanie Crossman, BTech(For's & AnalytChem) *Flinders,* Honours Student

Melissa Fettke, BSc *UAdel.,* Honours Student

Jaromir Guzinsky, BBiotech *UAdel.,* Honours Student

Nicola Renee Sleep, BTech(For's & AnalytChem) *Flinders,* Honours Student

See Appendix 3 for details of all students supervised by AWRI staff

Industry Development and Support

Peter William Godden, BAppSc(WineSc) *UAdel.,* Group Manager — Industry Development and Support

Mark Gishen, BE(Chem)(Hons), MEngSc(Chem) *UMelb.,* Quality Liaison Manager

Sally-Jean Bell, BSc(Hons) *UWA,* GradDip(Wine) *Roseworthy,* PhD *UWA,* Viticulturist

Adrian Dermott Coulter, BSc *Flinders,* GradDipOenol, *UAdel.,* Oenologist

Geoffrey David Cowey, BSc(Hons) *UAdel.,* Chemist

Matthew Grant Holdstock, BSc *Flinders,* GradDipOenol *UAdel.,* Chemist

Creina Standish Stockley, BSc(Hons) *UAdel.,* MSc *Flinders,* MBA *USthAust.,* Health and Regulatory Information Manager

Ella Margaret Clare Robinson, BA, BSc(Hons) *UAdel.,* Part time Chemist

Narelle Elizabeth Cream, Administrator – Industry Services

Communication and Information Resources

Raelene Joan Blair, CertAppMgt(Marketing) *AIM,* Manager — Communication and Information Services

Catherine Grace Daniel, BA *ANU,* GradDip(Lib) *RMIT,* Librarian

Ingrid Betty-Maud Oats, DipLibInfo *Adel. Tafe,* Library Technician

Melissa Elizabeth Francis, BA *UMelb.,* DipEd *Melb. State Col.,* Library Assistant

Kathryn Sarah Beames, Conference Secretariat

Susanne Judy Milnes, Conference Assistant (from 1 February to 15 August 2004)

Corporate Services

Hans Engelbert Muhlack, BEc *UAdel.,* CPA Aust., Company Secretary

Rachel Lee Edwards, Accountant

Jeffrey Mark Eglinton, BSc(Hons) *UAdel.,* Senior Computer Systems Officer

Rhonda Irene Milde, Administration Officer

Pauline Jorgansen, Administration Support

Julie Dawn McConnell, Administration Support (concluded 21 July 2004)

Renee Lee Parsons, Receptionist

June Robinson, Receptionist/Function Support (commenced 19 July 2004)

Jeanette Fay Tooley, Function Support (commenced 15 October 2004)

Analytical Service

Peter Charles Hans Eichinger, BSc(Hons), PhD *UAdel.,* Manager — Analytical Service

Sandra Margaret Lloyd-Davies, BA *Flinders,* Customer Service Manager

Maria Concettina Mills, Analytical Service Administration Support

Matthew James Cream, Laboratory Supervisor

Randell Leith Taylor, BSc(Hons) *UAdel.,* Trace Analysis Laboratory Supervisor

Gregory Andrew Ruediger, BAppSc *SAIT,* GradDipOenol *UAdel.,* GLP Supervisor (concluded 12 November 2004)

Caroline Jadvyga Sarneckis, BTech(For's & AnalytChem), BSc(Hons) *Flinders,* Analyst (commenced 2 December 2004)

David Rolfe Boehm, BSc *UAdel.,* Technical Officer

Carol Jean Sigston, BAgSc *UAdel.,* Technical Officer

Stephen Peter Ormiston Smith, BSc(Hons) *UTas,* BAppSc(Wine Sc) *CSU,* Senior Laboratory Technician (commenced 20 June 2005)

Daniel Scott Tynan, DipAppSc, *USthAust.,* Laboratory Technician

Slavko Matthew Bekavac, Laboratory Technician

Heather Mandy Brooks, Laboratory Technician

Dariusz Roman Kutyna, MSc *Ag.UPoland,* Laboratory Technician (commenced 18 April 2005)

Danielle Kylie Leedham, Laboratory Technician

Jelena Jovanovic, Laboratory Assistant/ Function Support

Highlights of the year

The quantification methods for 2,4-D in grapes and wine were developed in a short period of time (April to June 2005) in collaboration with staff of Research groups, Industry Development and Support and Analytical Service. The methods were applied for the analysis of survey samples (more than 100) received from AWBC.

A proposed industry 'standard' laboratory method for the measurement of the concentration of total anthocyanins in red grapes was prepared and presented to the Winemakers' Federation of Australia.

A robust and simple assay based on a precipitation protocol was validated for tannin measurement. This assay is ideal for incorporation into the standard suite of tools used for objective measurement of wine and grape parameters. We envisage that the technical simplicity of this assay will allow for widespread research and field applications.

The tannin team's poster 'The effects on red wine of pre- and post-ferment additions of grape-derived tannin' was awarded the prize for the best Oenology poster at the 12th Australian Wine Industry Technical Conference (July 2004 Melbourne, Vic).

Continuing investigations into alternative sample presentation modes for NIR scanning confirmed the feasibility of whole grape berry analysis, offering the potential to greatly speed up the testing of red grapes by such techniques.

The NIR team commenced the development of materials for training and teaching of the principles and use of multivariate analysis techniques (chemometrics) to other AWRI staff members as well as for industrial and external research partners, including for example, a workshop for Yalumba winemakers and viticulturists (September 2004).

Improved calibrations for the FOSS *WineScan* have been developed through the inclusion of Australian wine samples and NATA accreditation for the method has been achieved.

Four genes affecting volatile thiols release were identified and a gene encoding an alcohol acetyltransferases, *ATF1,* was implicated in the conversion of the volatile thiol 3-mercaptohexanol (3MH) to 3-mercaptohexyl acetate (3MHA). A number of commercial wine yeasts were identified as high capacity volatile thiol releasers and high capacity volatile thiol converters. This work offers the prospects of developing wine yeast starter strains with optimised volatile thiol release.

Hentie Swiegers was the recipient of the inaugural EDS Bioscience Scholarship.

The sensory evaluation capacity of the AWRI has been expanded considerably with Kate Lattey having successfully achieved a professional sensory analysis graduate certificate qualification and Belinda Bramley recently joining the sensory team.

Markus Herderich

To mark the 50th anniversary of the founding of the AWRI, the Industry Development and Support team organised the tasting and analysis of a range of Australian red wines that were being grown and made at the time of the AWRI's founding, from the vintages 1954, 1955 and 1956.

The AWRI *Solutions* section of the website was further enhanced, and a major new section on the establishment of winery laboratories was added.

The AWRI Viticulturist responded to 547 enquiries. The majority (87%) were regarding the use of agrochemicals for pest and disease control, the persistence of residues through winemaking and their effects on fermentation, and issues related to maximum residue limits in overseas markets.

Eleven thousand copies of the AWRI's annual publication, *Agrochemicals registered for use in Australian viticulture 2004/2005* were produced and duplicated on the Institute's website. The booklet was distributed with the *Australian Grapegrower and Winemaker, Technical Review* and in the *Research to Practice*™ IPM and Spray application manuals. The tables were featured in *Australian Viticulture* and *The Grapevine Management Guide 2004/2005* (Somers et al. 2004).

The Viticulturist and Jelka Software developed further the searchable database to replace the static retrieval of agrochemical information currently available from the AWRI's agrochemical website database. This database is similar to the currently existing MRL database except that it contains all the information related to and presented in the publication, *Agrochemicals registered for use in Australian viticulture 2004/2005.*

A common spray diary format was developed in conjunction with industry for the 2004/2005 season and was placed on the AWRI website. This format was successfully implemented and is now the recommended format for 2005/2006.

Several strains of *Saccharomyces* yeast and fermentation conditions have been identified which can not only produce monoterpenes but carry out their transformation, for example geraniol to citranellol.

Two inter-specific hybrid yeasts, *S. paradoxus-S. cerevisiae* (AWRI 1501) and *S. kudriavzevii-S. cerevisiae* (AWRI 1503), selected on the basis of pilot winemaking trials have, for the first time, been produced in sufficient quantity by AB Mauri for winemaking trials nationally. The wines will be evaluated to determine commercial viability of these novel wine yeasts.

A long-term study on the formation of damascenone in wine has now been completed with the synthesis of several glycoconjugated precursor compounds and analogues (models) of these precursors. These compounds gave damascenone in high yield. This behaviour is similar to that of several other glucosidic and aglycone precursors we have studied previously. The behaviour of the model compounds at wine pH has enabled us to understand what features of the various damascenone precursors are responsible for these precursors being converted to damascenone rather than to other (flavourless) products.

We have demonstrated that decreases in damascenone content during wine maturation are mainly due to the reaction with sulfur dioxide, forming a sulphonic acid derivative.

A new total synthesis of the nature-identical forms of *cis*- and *trans*-oak lactone has been achieved. The nature-identical *cis*-isomer was completely free of its *trans*-counterpart, and *vice versa*. Furthermore, the individual isomers were of a very high state of enantiomeric purity.

The Librarian spent four days demonstrating the AWRI Library database to Conference and Exhibition delegates at the 12AWITC and taking contact details to facilitate subsequent forwarding of access requirements to interested delegates following the Conference. Over 100 delegates requested the access details.

Staff of the John Fornachon Memorial Library responded to 3,559 requests for information during 2004/2005.

Over 3,900 records were added to the web-accessible database of the Library (available only to Australian winemakers and grapegrowers) during the year, making a total of over 32,000 records available for searching, 24 hours per day, 7 days per week. The database was used 1,723 times during the year.

A specialist wine and environment web-accessible database was established during the year, which is available to the general public via the AWRI's website. The database was used 1,712 times during the year.

The Twelfth Australian Wine Industry Technical Conference was conducted between 24 and 29 July 2004 in Melbourne Vic. The Conference program featured 11 international and 32 local speakers, presented over eight two-hour formal sessions and three colloquia. The conference registered 1,680 delegates and the Trade Exhibition showcased 206 local and international wine industry suppliers. Over the four days, 3,751 visitors attended the exhibition. The poster display featured 220 posters. Some 1,980 workshop places were sold to the 67 workshops.

AWRI published 53 papers on AWRI activities in refereed and non-refereed publications.

AWRI staff members gave 173 oral presentations, conducted 21 workshops and presented 72 posters.

AWRI staff members presented 58 lectures and coordinated a six week subject to undergraduate students.

AWRI staff members supervised/co-supervised 29 postgraduate students.

AWRI staff members recorded and responded to 6,495 requests for information during the 2004/2005 year or, to put the statistics into perspective, 26 people contacted the AWRI seeking information on every working day of the year. This figure does not include the amount of problem samples investigated (1,736) or the request for work through the Analytical Service which conducted 64,700 individual analyses during 2004/2005.

Readers are strongly encouraged to read the report in detail rather than relying on the brief details above for information.

Linda Bartoshuk (USA)

Staff activities

In addition to undertaking research and other projects described in this report, the AWRI performs a large number of external activities in support of the Australian wine industry.

Information on seminars, talks and poster papers given to outside organisations, academic lectures delivered, graduate students supervised, and the papers published is tabulated and can be found in Appendices 1–6 of the Annual Report. Activities in addition to those in the Appendices are described below.

Until 27 August 2004, **Peter Høj** was a member of the following:

- Premier's Science and Research Council (South Australia)
- Premier's Wine Council (South Australia)
- Compliance and Technical Advisory Committee (AWBC)
- Technical Committee (Winemakers' Federation of Australia)
- Provisor Pty Ltd Board
- Cooperative Research Centre for Viticulture II (CRCVII) Board
- Wine Committee (Royal Agricultural and Horticultural Society of South Australia)
- Waite Campus Management Committee
- Committee of Management, Viticultural Publishing, publisher of *Australian Journal of Grape and Wine Research*
- Editorial Board of the *Journal International des Sciences de la Vigne et du Vin*
- Conference Planning Committee of the Twelfth Australian Wine Industry Technical Conference (24-29 July 2004, Melbourne) (Chair)

He was also the AWRI's representative on The University of Adelaide's School of Agriculture and Wine's Advisory Committee and the Management Committee. Professor Høj also held the Australian Wine Industry Chair of Oenology at The University of Adelaide. Professor Høj continues his membership of the Prime Minister's Science, Engineering and Innovation Council.

Sakkie Pretorius is a member of the Wine Industry Technical Advisory Committee (WFA); Editorial Board of the following journals: *American Journal of Enology and Viticulture, Annals of Microbiology, FEMS Yeast Research* and *Yeast*. He was also the Co-Chair of the Program Sub-Committee of the Twelfth Australian Wine Industry Technical Conference and is the Chairman of the Conference Planning Committee of the Thirteenth Australian Wine Industry Technical Conference. He is also an Affiliate Professor of the University of Stellenbosch and The University of Adelaide. Sakkie is a member of the Wine Innovation Cluster's Steering Committee, is Chairman of the WIC's Project Control Group and Co-Chair of the WIC's Science Integration Committee.

Markus Herderich is Leader of Project 1.2, the 'Tannin project', of the Cooperative Research Centre for Viticulture II (CRCV2), Affiliate Associate Professor at The University of Adelaide and he is a member of the Advisory Board of the *Journal of Agricultural and Food Chemistry.* Markus is a member of the Wine Innovation Cluster's Central Technical Reference Group.

Eveline Bartowsky serves on the Joint Editorial Board of the following journals: *Journal of Applied Microbiology;* and *Letters in Applied Microbiology.* She is a member of The University of Adelaide's School of Agriculture and Wine Occupational Health and Safety Committee, Waite Campus Occupational Health and Safety Liaison Committee, and is an Affiliate Lecturer at The University of Adelaide.

Paul Chambers is a member of the organising committee for the *XXIII International Conference on Yeast Genetics and Molecular Biology* to be held in Melbourne in 2007; a member of the Yeast: Products and Discovery committee, and is coordinator of the Australian Yeast Group (through its homepage at http://www.australianyeastgroup.org/).

Leigh Francis is a member of the Editorial Board of the *Journal of the Science of Food and Agriculture,* and is also an Affiliate Lecturer at The University of Adelaide.

Holger Gockowiak is a member of the Wine Innovation Cluster's Central Project Control Group.

Paul Henschke serves on the Editorial Review Board of the following journals: *Australian Journal of Grape and Wine Research; Food Microbiology;* and *Mitteilungen Klosterneuburg.* He is a member of the organising committee for the *XXIII International Conference on Yeast Genetics and Molecular Biology* to be held in Melbourne in 2007.

Mark Sefton is on the editorial review board of the *International Journal of Vine and Wine Sciences* and is the project leader of project 1.3 of the CRCVII. He is also an Affiliate Senior Lecturer with The University of Adelaide.

Elizabeth Waters is an Associate Editor for the *Journal of Agricultural and Food Chemistry* and is a Program Manager of the Cooperative Research Centre for Viticulture II (CRCV2).

Peter Godden was a member of the Conference Planning Committee for the 12th AWITC and Program sub-Committees and the Workshop Coordinator of a program of 67 workshops held at the Twelfth Australian Wine Industry Technical Conference. He is also an Associate Judge at the Royal Adelaide Wine Show (since 2001). Peter is a member of the Wine Innovation Cluster's Central Technical Reference Group.

Mark Gishen is leader of project 1.4 of the CRCVII, and is the AWRI's representative on the Winemakers' Federation of Australia (WFA) Legal Metrology Group.

Creina Stockley is an Affiliate Senior Lecturer, School of Agriculture and Wine, The University of Adelaide. She is a member, Wine Industry Technical Advisory Committee (as Technical Liaison); Member, AWBC Legislation Review Committee; Member, Wine Industry National Environment Committee; Member, CRCV 'Good Environmental Management' Project Reference Group; Member, Australian delegation to the Organisation de la Vigne et du Vin; Vice-President, Nutrition and Wine Expert Group of the Office de la Vigne et du Vin; Member, National Drug and Alcohol Research Centre's Young People and Alcohol Project Advisory Group; Member, Scientific Committee, Vindaba Wine and Health International Congress 2005; International Consultant, Center for Wine and Cardiovascular Health, University of Alabama; Member, Waite Campus Executive Committee/Waite Facilities Services and Amenities Committee; Board Member, The University of Adelaide's Children's Services.

Rae Blair was a member of the Conference Planning Committee for the 12th AWITC and is the Public Officer, Treasurer and Conference Manager of the Australian Wine Industry Technical Conference Inc. She is a member of the Wine Innovation Cluster's Steering Committee, Project Control Group and Technical Reference Group, and was a member of the judging panel for the 2005 *World Food Media Awards.*

Catherine Daniel is a member of the ALIA Special Libraries Section (SA) Branch.

Matthew Cream serves on the Interwinery Analysis Group Committee.

Visitors to the AWRI

Australia

Peter Lye and **Ron Bradbury,** Charles Sturt University (6-7 September 2004)
Steve Davis, CRC Micro Technology (10 September 2004)
John Considine, University of WA (16 November 2004)
Brian Trussel, Rapak Asia Pacific (18 November 2004)
David Donald, James Cook University (13-14 December 2004)
Terry Cocks and **Phil Purdy,** Integrated Spectronics (18-19 December 2004)
Joe Shapter, Flinders University (27 January 2005)
Martin Miller, BioInnovationSA (1 February 2005 and 16 March 2005)
Mark Gibberd and **Kerry Wilkinson,** Curtin University of Technology, Margaret River Education Campus (3 February 2005)
Sue Hodder, Wynns Coonawarra (16 February 2005)

Antonio Dottore, Education Centre for Innovation and Commercialisation (21 February 2005)
Geoff Scollary, National Wine and Grape Industry Centre (22 February 2005)
John Stocker, Foresight & Associates (23 February 2005)
Grant Stanley and **Sarah Fraser,** Victoria University (7 March 2005)
Garth Swinburne, Scholefield Robinson (11 March 2005)
Tony Clancy, GWRDC; **Karen Hellwig,** Horticulture Australia Limited; **Maureen Cribb,** Grains Research and Development Corporation; **Murray Hansen,** Rural Industries Research and Development Corporation; **Megan Ball,** Wool Innovation; **Neale Price,** Sugar Research and Development Corporation; **Tim Lester** and **Kate Andrews,** Land and Water Australia (11 March 2005)
Attila Tottzler, Advanced Analytical (4 April 2005)
Frank Placanica, Orlando Wyndham (6 April 2005)
Robin Ling, Viticulture Technologies (2 May 2005)
Russell Johnson, Beringer Blass (5 May 2005)
Colin Jeffress, Jeffress Engineering (6 May 2005)
Tony Steeper, CSIRO (13 May 2005)
Tom Hester, Viticulture Technologies (17 May 2005)
Andrew Southcott, Federal Member for Boothby (27 June 2005)

International

Bulgaria
Group of Bulgarian winemakers (11 July 2004)

Canada
Isabelle Lesschauve, Brock University (3–5 August 2004)

Chile
Edmundo Bordeu and **Dr Alvaro Gonzalez Rojas,** Pontificia Universidad Catolica de Chile, Santiago (3 August 2004)

Diego della Maggiora, Indura, Santiago (3 August 2004)

Matías Lema Mehech, San Pedro Winery; **Bernhard Karl Frisius Siniavschi,** Santa Helena Winery; **Alvaro Asenjo Marquéz,** Dussault-San Pedro Winery; **Ignacio Cristian Conca Prieto,** Terranoble Winery; **Manuel José Henríquez Mandiola,** El Aromo Winery; **Alejandro Parot Fernández,** El Abate Cellar; **Yerko Moreno Simunovic,** Lomas de Pangal Winery; **Cristian Correa Díaz,** Santa Laura Winery; **Ricardo Antonio Araneda Nuñez,** MontGras Winery; **Rubén Díaz Peña,** Anakena Wine; **Patricio Enrique Middleton Klapp,** Colchagua Winerys; **Carlos Muñoz Alarcón,** Copeval; **Alejandro Soto Araya,** CORFO; **Rodrigo Moisan Ubill,** Wines of Chile 2010 (11 November 2004)

Eduardo Chadwick, Viña Errázuriz; **Jorge Matte,** Errázuriz Group; **Raul Baumann,** Errazuriz Group; **Francisco Baettig,** Errázuriz Group; **Wladimir Medel,** El Descanso Estate; **Pedro Contreras,** Panquehue Estate; **Gonzalo Bertelsen,** Caliterra; **Ed Flaherty,** Seña (15 November 2004)

Denmark
Asmund Rinnan, FOSS (1 April 2005)

Peter Somers and colleagues, Chr Hansen (3 August 2004)

France
Jean-Marie Sablayrolles, INRA, Montpellier (21 July 2004)

Claude Espeillac, Directeur Général Boissons Fermentées, Lallemand, Blagnac (26–27 August 2004)

Phillippe Guillomet, Laffort Œnologie (1 November 2004)

Grégory Péruchon, Rapak Europe (18 November 2004)

Pascal Brunerie, Pernod Ricard (6 April 2005)

Veronique Bellon-Meurel, Cemagref (7 April 2005)

Jean-Michel Lebeault, University of Technology of Compiègne (24 April 2005)

Germany
Oliver Schmidt, LVWO Weinsberg (16 March 2005)

Claus-Dieter Patz, Geisenheim Research Institute (20–22 July 2004)

Sibylle Krieger, Lallemand, Stuttgart (21 July 2004)

Wolf-Rüdiger Sponholz, Forshungsanstalt Geisenheim (4 February 2005)

Japan
Sumito Koyanagi and **Taketoshi Murata,** Kirin Brewery Ltd (27 June 2005)

New Zealand
Peter Schroeder, Rapak Asia Pacific (18 November 2004)

Singapore
Felix Yeung and **Sophia Ku,** CPG Laboratories (27 January 2005)

South Africa
Helene Nieuwoudt, Stellenbosch University (19 July 2004)

Marius Lambrechts and **Riel Tredoux,** Distell Winery (19 July 2004)

Brunhida Luyt and **Marco Ventrella,** Graham Beck Wines (5 August 2004)

Karien Lourens, Anchor Bio-technologies (16 November 2004)

Marinda Swanepoel and **Len Knoetze,** WestCorp International (29 April 2005)

Spain
Fernando Vilarina, Consejo Regulador de la Denominacion de Origin Rias Baixas, Pontevedra (17 January 2005)

Jordi Pagef, Drafinof (7 March 2005)

United Kingdom
Amanda Evans, Cambridge University (19 January 2005)

USA
Leslie Norris, FlavorSense (19 July 2004)

Gerry Ritchie, Napa Valley College (11 January 2005)

Anthony Borneman, Yale, New Haven (31 March 2005)

OIV Wine Marketing Students: (8 March 2005)
Kata Adasz, University of Budapest, Hungary; **Nicolas Chain,** EPSCI, France; **Géraldine Corrales,** Ecole Centrale Paris, France; **Philippe Chainier,** Business School of Plymouth, United Kingdom; **Olivier Condette,** France; **Vincent Delcher,** France; **Anna Dimitriadis,** University of Macedonia, Greece; **Francisco Guedes Almeida,** Université Catholique Portugaise, Portugal; **David Hourdry,** University Paris X, France; **Camille Jouffroy,** France; **Daniel Looney,** Illinois State University, USA; **Fabrice Mauge,** Ecole d'Ingénieurs Biologie Industrielle, France; **Marie-Mélodie Morange,** Université de Poitiers, France; **David Rieu,** Cadre commercial filiére Vins, France; **Renée Saunier,** University of Kentucky, USA; **Sylvain Soulairac,** Université de Montpellier, France; **Jim Sun,** Shandong University, China; **Jean Philippe Turgeon,** Université du Vin, Canada; **Yumiko Ueno,** Tezukayama University, Japan

Report on the Twelfth Australian Wine Industry Technical Conference (12 AWITC)

Program

With three years in the planning and a 30+ year history behind it, it was always going to be a big event. Despite experiencing tight financial conditions, the Australian wine industry showed its commitment to innovation, research and development and turned up in record numbers (1,680 delegates) and truly participated.

The event was not for the faint-hearted: delegates needed good time management skills to negotiate the extensive program on offer over six days. Truly dedicated delegates embraced the opportunities and commenced most days at 8:00 am and did not finish until late in the evening. The challenge for each day was unrelentless: attending a workshop and contributing in the 'hands-on' environment; grabbing a bite to eat 'on the run' whilst discussing the latest technology, services and products on offer with the 206 local and international trade exhibitors; turning up at the formal sessions on time and stretching the technical knowledge; walking the maze of 220 posters and absorbing the future direction of wine industry research and development; attending a specialised colloquia; and finally trying to find time to undertake informal discussions with colleagues representing all aspects of the wine industry from Australia and around the world.

Held at the Melbourne Convention and Exhibition Centres, delegates stretched their legs between formal sessions by walking across a covered footbridge which spanned the Yarra River and connected the two venues. The City of Melbourne provided a stunning backdrop to the presentations and discussions amongst local and international peers on all things technical and contemporary.

The program was developed by a group of practicing viticulturists, winemakers and researchers in Australia for the benefit of the Australian wine industry. The Program Sub-Committee was Co-Chaired by the AWRI's Managing Director, Sakkie Pretorius and Dr Richard Hamilton (Southcorp Wines). The Sub-Committee's 'wish list' resulted in invitations being accepted by eleven international speakers from Canada, Chile, France, Singapore, Spain, UK and the USA. The international speakers and the 32 Australian speakers gave presentations in the formal program and the colloquia that addressed the most important technical issues facing the Australian wine industry today.

The eight formal sessions covered the industry, the environment, wineries, vineyards, sensory studies, consumers, storage and transportation. Each two hour session was well attended by interested practitioners and generated many questions from the floor. The formal sessions commenced with well-known futurist, Phil Ruthven, painting a picture of the world economy, the world wine market and Australia's position within this now and in the future. His presentation led onto presentations covering developing new markets, consumer behaviours, developing products guided by consumer preference and the physiology of taste. The formal sessions presented on Monday then turned to viticulture and balanced wine: managing vineyard physiology and variability, root to shoot signaling, crop load, managing variability in vineyards, precision viticulture, warm/hot climate viticulture, vine balance, managing the pros and cons of sunshine, bunch exposure, tannins, and objective measures of grape quality.

Wine and the environment was discussed on Tuesday covering topics such as tuning of wine composition, GMOs, water use efficiency, environmentally-friendly pest management, environmental impact of Australian wineries, winery design, and irrigation in the Murray Darling Basin. Transport and storage (including producer and retailer viewpoints) was discussed on Wednesday, along with flavour scalping and closure performance. The formal sessions concluded with a lively 'hypothetical' entitled *2025 inquiry into the Australian wine industry's performance in the Asian market.* High-profile Melbourne QC, David Galbally, acted as the Inquiry Moderator, delving into the reasons for the Australian wine industry's failure to gain significant market share in Asia in the year 2025. A panel of expert witnesses gave testimony on market intelligence and delivery, production and development and R&D, education and extension. Australia's Chief Scientist, Dr Robin Batterham, gave an impromptu contribution, and there were many thought-provoking contributions from the floor.

The formal program was solidly supported by more specialised technical presentations. This was achieved with the presentation of well attended colloquia (three held on different days and covered viticultural input for sustainability, control of the winemaking process and setting new goals for wine and vine design with R&D) and an ambitious workshop program.

Workshops

Over 1,980 workshop places were sold for the 67 workshops on offer, held over six days. The workshop program was coordinated by Peter Godden, Narelle Cream and Ella Robinson, with support from Gerard Hogan (CRCV).

Each workshop was kept necessarily small, to encourage a 'hands on' experience and to optimise discussion and interaction. The first workshops to sell out were *Red wine phenolics, Managing grape quality in the vineyard* and Wine flavour, and over half of the workshops

had been sold out within four months of the registration brochure being distributed. A selection of other popular workshops were *Winemaking with non-conventional yeast,* Brettanomyces – *latest research and control strategies, Salinity in the vineyard, Dryland viticulture, Pest and disease monitoring and identification, Oxidation of wine, Chardonnay clonal trial, New varieties and new regions, Port: a palateful of complexity, Berry sensory analysis, Wine microbiological spoilage, Screwcaps for small and medium winemakers* and *The influence of environment on grapevine yield.* The proceedings from popular workshop *Managing vineyard variation* (Precision viticulture) are now available from the AWITC website (www.awitc.com.au).

Posters

The record number of technical posters on display provided an unparalleled opportunity for practitioners to be aware of the wide range of research and development currently being undertaken for the industry. The Poster display was coordinated by Randell Taylor and Russell Johnstone (Orlando-Wyndham). The 220 posters were divided into the following categories: *Clarification and maturation; Fermentation; Grape and wine aroma, flavour and colour; Grapes, wine and the environment; Information and technology transfer; Microbial spoilage; Miscellaneous; New vineyard technologies; Pests and disease; Phenolics for red wine; Soil and irrigation management; Vine and berry science; Vine nutrition; Wine and grape composition and analysis; Wine and health;* and *Wine contamination.* Delegates had the opportunity to discuss the progress of the research with poster authors during two dedicated poster sessions. The Australian Society of Viticulture and Oenology awarded three poster prizes, and the *Australia and New Zealand Grapegrower and Winemaker* awarded one poster prize. The AWRI's 'team Tannin' received the only oenology-based award on offer: the Australian Society of Viticulture and Oenology's Best Oenology poster, for their poster entitled:

The effects on red wine of pre- and post-fermentation additions of grape-derived tannin.
P. Smith, M.J. Birse, M. Parker, M.J. Kwiatkowski, H. Gockowiak, M.J. Herderich

The recipients of the other three poster prizes were the following posters and authors:

Australia and New Zealand Grapegrower & Winemaker's Best Pest and Diseases poster:

More to grapes than you think - a bird's eye view.
V.P. Saxton, G.L. Creasy, A. Paterson and M.C.T. Trought. (Lincoln University, Centre for Viticulture and Oenology and Marlborough Wine Research Centre)

Australian Society of Viticulture and Oenology's Best Viticulture poster:

Remotely sensed grapevine canopy descriptors: relationships with fruit composition and yield.
A. Hall, J. Louis, D. Lamb, B. Holzapfel. (CRCV, NWGIC, and Centre for Spatial Sciences, School of Biological, Biomedical and Molecular Sciences, University of New England).

Australian Society of Viticulture and Oenology's Best Student poster:

Vineyard soil degradation following irrigation with saline groundwater for twenty years
L. Clarke, R.W. Fitzpatrick, M.G. McCarthy, R.S. Murray, D.J. Chittleborough, J.L. Hutson (The University of Adelaide, CSIRO Land and Water, SARDI, Flinders University and CRCV).


David Woods (Hardy Wine Company)

Proceedings

The proceedings from this event were edited by Rae Blair, Pat Williams and Sakkie Pretorius. They have been produced in hard copy and on CD. Summaries of the posters are included in the hard copy of the proceedings, whilst the full posters (where available) are provided on the CD.

Trade Exhibition

Held alongside the Conference was the 12th Australian Wine Industry Trade Exhibition (AWITE). This was the first exhibition held in partnership with Reed Exhibitions. The AWITE attracted more than 200 exhibiting companies demonstrating new directions, technologies and solutions for grapegrowing and harvesting through to winemaking, marketing and distribution. For the first time at an Australian wine industry trade exhibition, there was an international pavilion featuring French and Italian exhibitors. The record number of trade exhibitors and the presence of an international pavilion was of enormous benefit to visitors and conference delegates, and was as a result of the interaction of Reed's international network of offices. Some 3,751 people (including conference delegates) visited the trade exhibition. Under the alliance between Reed Exhibitions and the AWITC, Reed will organise the next AWITE to be held in conjunction with the thirteenth AWITC in Adelaide in 2007.

Conference Planning Committee

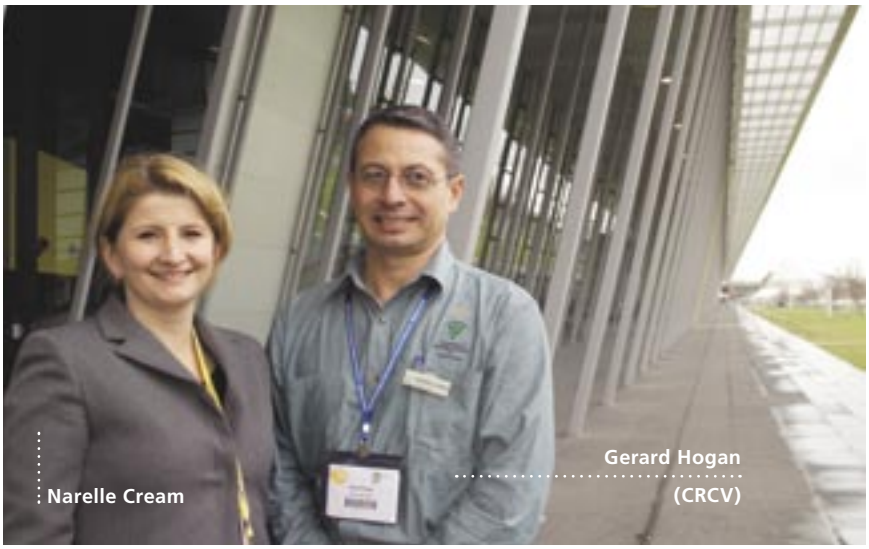
The Conference Planning Committee comprised Peter Høj (Chairman), Rae Blair (Conference Manager), Chris Dundon (FABAL), Peter Godden (AWRI), Kate Goodman (The YarraHill), Richard Hamilton (Southcorp Wines), Russell Johnstone (Orlando Wyndham), Michael Kerrigan (Howard Park Wines), Sakkie Pretorius (AWRI), Louisa Rose (Yalumba Wines), Garry Wall (ASVO), David Wollan (Wine Network Australia). Conference Secretariat comprised Kate Beames and Sue Milnes.

Sponsorships

The following sponsors are acknowledged for their support of this event:
Netafim; Seguin Moreau; Amorim; Australian Winemakers, The Australian Wine Research Institute, The Stephen Hickinbotham Memorial Research Trust, The Thomas Walter Hardy Memorial Trust, Grape and Wine Research and Development Corporation, Australian Society of Viticulture and Oenology, Winetitles, Liquid Assets and Provisor.

13 AWITC

Planning for the Thirteenth Australian Wine Industry Technical Conference has already commenced with the confirmed dates of 28 July to 2 August 2007 and to be held in Adelaide, SA. The Australian Wine Industry Technical Conference Inc. and Reed Exhibitions are currently in negotiation with the Wine Industry Suppliers' Association (WISA) to jointly conduct the trade exhibition for this event.


Narelle Cream

Gerard Hogan (CRCV)

Interactions of non-volatile and volatile compounds in wine: major influences on wine flavour perception

Staff and students

Patrik Jones, Ken Pocock, Richard Muhlack, Jean Macintyre, Felicity Lloyd, Paul Chambers, Liz Waters

Collaborators

Simon Nordestgaard, Chris Colby and Brian O'Neill (School of Chemical Engineering, University of Adelaide), Audrey Lim (Hardy Wine Company), Leon Deans (Orlando Wyndham), Allen Hart (Fosters Wine Estates), Filomena Pettolino and Tony Bacic (CRC for Bioproducts, University of Melbourne), Eileen Scott and Belinda Stummer (School of Agriculture and Wine, University of Adelaide)

This project combines research on protein instability in wine with aspects of the sensory consequences of interactions between proteins, and other polymers in wine, with other wine components.

Improving the efficiency of bentonite fining through chemical engineering

Batch-wise addition of bentonite is used commonly for the removal of white wine proteins responsible for haze formation, with adsorption of haze forming wine proteins onto bentonite being primarily due to the cationic exchange capacity of the bentonite clay. While bentonite is effective in removing the problem proteins, it is claimed to adversely affect the quality of the treated wine, particularly at high bentonite doses. Furthermore, because of bentonite's considerable swelling and poor settling characteristics, 3% to 10% of the wine volume is occluded by the bentonite lees. Therefore the development of alternative and economically viable process technologies that maintain wine quality and reduce costs is highly desirable.

We collaborate with the School of Chemical Engineering, University of Adelaide on a project aimed to improve the efficiency of bentonite fining. One of the first steps has been to gain an understanding of adsorption of grape protein onto bentonite. We have used one of the major wine proteins, VvTL1, and a commonly used sodium bentonite in bentonite adsorption studies. Adsorption capacity was found to be higher at pH 3.0 than at pH 3.4, and at 24°C than at 5°C. This is consistent with industry observations that "the more acid the wine, the more effective is the removal of protein" and "removal is more effective in warm than cold juice or wine". Changes in ethanol content from 10% to 13% v/v did not effect protein adsorption.

Peter Høj

Field trials have been undertaken at several wineries to assess the efficacy of in-line dosing of bentonite for protein haze removal. Preliminary indications are that in-line dosing is as effective as batch fining for protein stabilisation. The minimum contact time appears to be less than two minutes. Provided the carry over of bentonite post-centrifuge is minimized, it also appears that in line dosing has significant potential to reduce wine volume loss.

Protein haze formation

Many different tests have been proposed over the years to predict protein stability of bottled white wine, generally with little or no storage test results. Based on the work undertaken by Bryce Rankine and Ken Pocock over 30 years ago, the AWRI recommends the 80°C for six hours test, advising winemakers to interpret the results in the light of their own experience. Some winemakers consider that this test is too severe, resulting in wines being over-fined with bentonite.

We have initiated a research project to re-examine the suitability of the current heat test to predict protein stability of bottled white wine and to compare this test with two alternative assays (80°C for two hours and the Bentotest). Eight unfined white wines, donated by industry collaborators have been used in the project. The three predictive assays (80°C for six hours, 80°C for two hours and the Bentotest) were used to determine bentonite-fining rates required for stability for each wine. Through Provisor, an aliquot of each of the wines was fined at the rates predicted by the three different assays, bottled and then stored with bottles of their unfined counterparts at 15°C, and at either 35°C for one month or cycling between 35°C and 20°C daily for eight days.

The storage trial at 15°C has now been running for up to ten months. At this stage only one unfined wine has developed a haze and this trial will continue for several years. Seven of the eight unfined wines became hazy in the 35°C storage trials, but no hazes occurred in any of the fined wines. Thus all tests, including the least stringent in this experiment (80°C for two hours) have correctly predicted stability under these severe storage conditions. These results suggest that use of Bentotest and the 80°C for six hours heat test could lead to over-fining with bentonite as the smallest addition of bentonite, which was based on results from the 80°C for two hours assay, was sufficient to achieve the haze stability.

Haze protective factors

An alternative to the removal of haze forming wine proteins from wine with bentonite involves the addition of polysaccharides with haze-protective activity to wines. Two *Saccharomyces cerevisiae* mannoproteins exhibiting such haze protective activity (Hpf1p and Hpf2p) have been identified, and a *S. cerevisiae* strain overexpressing a gene for a hexahistidine labelled form of Hpf2p (6xHisHpf2p) has been produced.

A preliminary storage trial was conducted. A heat unstable Sauvignon Blanc wine containing 6xhisHpf2p (200 mg/L), yeast invertase (200 mg/L) or no addition ('control') was stored at 25°C. After 3, 6 and 12 months' storage none of the wines, including the control had developed haze. During the heat test, both 6xhisHpf2p and invertase appeared to be as active after 3, 6 and 12 months' storage as they were when the trial was set up, reducing the haze to 50% and 70%, respectively of that developed in the control. This data indicated that the short to medium term stability of these haze protective manno-proteins in wine was good, even at slightly elevated temperatures. After 24 months' storage, the activity of both 6xHisHpf2p and invertase was similar to that exhibited previously, by each after a heat test. Upon storage, for 24 months however, all of the wines had developed a slight haze.

These data confirm that both 6xHisHpf2p and yeast invertase are relatively stable in wine and continue to show haze protective activity during storage, but that their addition to wine would probably not result in that wine being sufficiently stable for commercial release. We continue our strategy to pinpoint the active component of the haze protective factors as such a component is likely to have a much enhanced activity to mass ratio compared to the native mannoproteins, thus allowing us to stabilise white wine through addition of much smaller amounts of the protective factors.

The sensory consequences of interactions of wine components

This part of the project is part of the CRC for Viticulture project 1.2, 'Tannin and colour'. Our aim in this subproject is to assess the relative importance of major components and component groups that influence the perception of wine sensory properties either directly or through interactions with other components. The initial experiments involved separating wine component groups, such as phenolic compounds, proteins and polysaccharides, from wine and subjecting combinations of these purified component groups in wine like solutions to quantitative sensory descriptive analysis.

Data collected to date indicate that ethanol has a direct enhancing effect on many 'unpleasant' palate attributes such as hotness, bitterness, metallic and drying. The overall perceived flavour was also significantly higher at higher ethanol levels (13% v/v) in the presence of glycerol compared to samples without glycerol.

The effect of polysaccharides, glycerol and ethanol on perceived viscosity was not simple and it is not clear yet how perceived viscosity relates to other commonly used sensory terms/descriptors such as fullness, body and density —we hope to clarify this in future studies.

Tracey Siebert

These data have shown clearly that wine components interact with one another to influence the sensory outcome and indicate that sensory studies in which components are assessed in isolation may give an incomplete picture of the overall importance of particular wine components on wine sensory properties.

Defining, measuring and controlling important volatile aroma and flavour compounds in grapes and wine

Staff and students

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Collaborators

Philip Marriott (RMIT University), Peter Winterhalter (Technical University of Braunschweig)
This project is part of the CRC for Viticulture.

Formation of important wine flavour compounds from grape-derived precursors

Damascenone (β-damascenone) is one of the most important natural aroma compounds known; it has been identified in many different types of plant material and is also one of the mainstays of the international perfume industry. Damascenone is also an important grape-derived aroma and flavour compound and is said to add to overall aroma intensity in wine. It is a member of a group of thirteen-carbon secondary metabolites with the megastigmane skeleton, which are widely distributed in plants and plant products. Most of these compounds contain oxygen at the C_9 position, which is presumed to have resulted directly from oxidative cleavage of carotenoid precursors. Simple carotenoid degradation alone, however, cannot generate 7-oxygenated megastigmanes such as damascenone directly. As damascenone can be formed by mild acid hydrolysis of crude glycoconjugate fractions from grapes, much research in this laboratory has focussed on chemical mechanisms for the formation of damascenone in wine, involving acid-catalysed rearrangement of 9-oxygenated precursors.

This long-term chemical study has now been completed with the synthesis of several glycoconjugated precursor compounds and analogues (models) of these precursors. Hydrolysis of two allenic glucosides at wine pH and room temperature was complete after several days. These compounds gave damascenone in high yield. This behaviour is similar to that of several other glucosidic and aglycone precursors we have studied previously. The behaviour of the model compounds at wine pH has enabled us to understand what features of the various damascenone precursors are responsible for these precursors being converted to damascenone rather than to other (flavourless) products.

We have also followed the evolution of damascenone (and other wine components) in several red and white wine varieties during production in a commercial winery. In all cases, the evolution of damascenone during vinification was rapid, and the maximum concentration was reached before bottling. This rapid evolution was consistent with that reported earlier by a German researcher for a single wine, and was also consistent with the reactivity of the various precursors we have studied. Samples of grapes and must were also taken in our study, and we are currently investigating these in order to devise a simple treatment (based on the chemical studies) which will form damascenone in a quantity that is representative of that found in the commercial wines. This will enable us to develop a method for assessing damascenone potential in grapes that does not involve the complex task of trying to measure the many and varied individual precursors.

In addition to studying the evolution of damascenone during the production of these commercial wines, we have also monitored changes in concentration in several known and putative precursors to 4-ethylphenol and 4-ethylguaiacol, which are formed by the action of *Brettanomyces* yeasts in wine. This information will help to determine which of these potential precursors require further investigation as part of the AWRI's research into *Brettanomyces* problems.

Further investigation of these commercial wines, and also an earlier German report, indicated that damascenone can be lost during bottle ageing. We have therefore conducted a study into the reactivity of damascenone towards various wine components, in an effort to determine and understand the reasons for this loss. In the presence of wine acids, but the absence of other wine components, damascenone was slowly converted into several other products. However, the rate of these transformations was too slow to fully account for the decreases in damascenone concentration observed in commercial wines. Damascenone reacted slowly with other acidic and basic compounds, more quickly with thiols, and most rapidly with sulfur dioxide. The reaction product of damascenone and sulfur dioxide was isolated and shown to be an odourless sulphonic acid. The formation of this compound was irreversible, even in the presence of a high concentration of acetaldehyde, a well-known sulfur dioxide scavenger. A detailed investigation into the effect of SO_2 demonstrated that loss of damascenone in model wine was directly related to the concentration of added SO_2, as expected, but was essentially unaffected by a change in pH from 3.4 to 3.2.

Decreases in damascenone content during wine maturation can be attributed to several factors, but it is the interaction with sulfur dioxide that is likely to be the most important process accounting for such losses. These results also explain our observations of higher damascenone levels in more oxidised wines (which have lower levels of SO_2) in an earlier scalping study and in the trial conducted by the AWRI's Wine and Oxidation team on the effects of closure, ascorbic acid and bottle storage position on the composition and sensory properties of white wine.

Mark Sefton

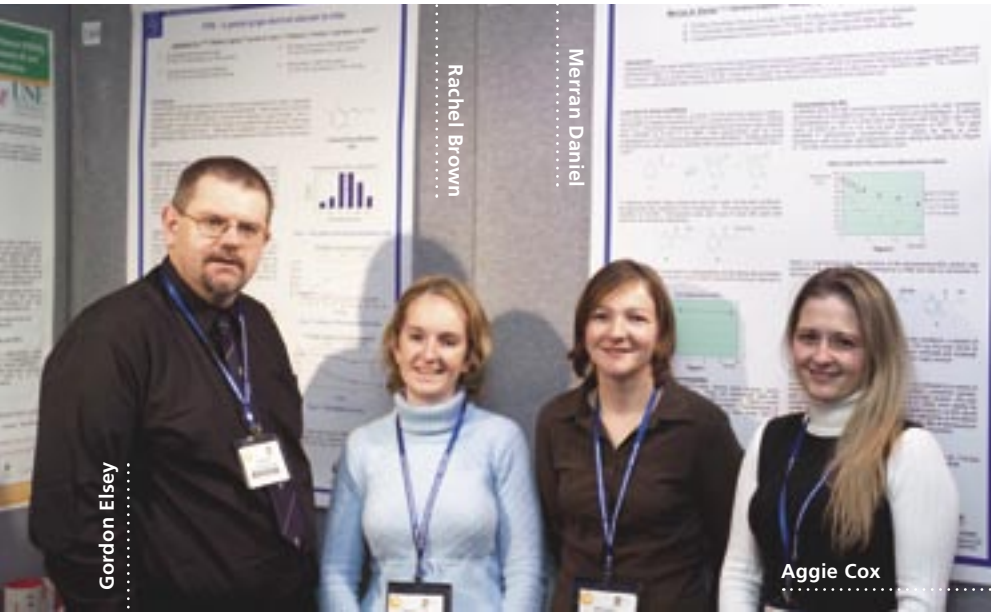
Although damascenone is formed hydrolytically from grape-derived precursors, it is essentially a young wine component. This contrasts with the situation for some other wine flavour compounds such as TDN (kerosene-like character) which are formed more slowly from precursor forms, are chemically stable, and are therefore found in higher concentration in older wines.

Wine lactone is a potent grape-derived (monoterpene) odorant in wine. It has an aroma similar to that of *cis*-oak lactone, i.e. woody and coconut-like, and is associated with older wines. We have completed a detailed kinetic study into wine lactone formation from two grape metabolites which were earlier synthesised in our laboratory. Previous work by other researchers had suggested that these two metabolites were important precursors of wine lactone. Our results, however, have shown that the formation of wine lactone from these precursors is slow at room temperature, and, while they could account for wine lactone accumulation in wines that are several years old, they do not account for the wine lactone that is present in younger wines. These results show that there is at least one other, as yet unidentified, precursor that accounts for the early formation of wine lactone in younger wine.

Identification of new grape and wine flavour components

Following a detailed sensory analysis of 18 Shiraz grape homogenates from different vineyards (see previous Annual Report), homogenates of 'peppery' grapes were analysed by static headspace GC-MS (HS-GC-MS) using a Cool Inlet System (CIS). Vectors obtained by analysis of over 132,000 individual mass spectra (selected from > 13,000 per analysis) were then subjected to multivariate analyses. Both principal component analysis (PCA) and partial least squares (PLS) were used to develop multivariate models to explain the intensity of the rating of the 'peppery' character in the homogenates. This allowed us to narrow our focus to several compounds, which might be related to the 'pepper' characteristic in the grape homogenates. Additional optimisation of the methodology enabled a single region of the GC-MS chromatogram to predict 'pepperiness' with a correlation > 0.98 and led to the identification of a compound that acts as a marker for this sensory characteristic. Although the relationship between the concentration of this marker and 'peppery' character does not appear to be one of cause and effect, it is possible that the compounds giving pepperiness are structurally related to the marker compound. The marker is not available commercially and will have to be isolated from an essential oil in which it is a component.

In a recent field trip to core industry collaborators in key regions in Victoria, a sampling protocol was developed for the 2005 vintage, with the objectives of investigating how 'pepper' aroma and flavour develops in Shiraz berries over time, the impacts of vineyard aspect and site selection on Shiraz pepperiness, and the relevance and application of the marker compound detected by the GC-MS multivariate study.



Analysis of wine components and their precursors

Following the completion of our synthetic program for producing stable isotope-labelled analogues of several important thiols for use as internal standards in measuring these important compounds in wine, we have successfully completed a large scale synthesis of several actual and putative grape-derived precursors to these compounds. Some have also been made in labelled form to enable their quantification in grape samples. They are also essential to further studies on their metabolism by wine yeasts and their biosynthesis in grape samples.

Two-dimensional gas chromatography techniques combined with TOF mass spectrometry for the analysis of wine lactone in wines are currently under investigation, in collaboration with a group in Melbourne. Using this method, we can separate the two enantiomers of wine lactone (one is extremely potent, the other odourless) and obtain excellent sensitivity (down to a concentration of 100 ng/L, the threshold value for wine lactone in a model wine). However, there are still some problems regarding accuracy of measurement which need to be solved before the method can be applied routinely. In the meantime, a more conventional analytical method that we have developed is suitable for determining wine lactone in wines in which this compound is present in relatively high amounts.

Synthesis and sensory properties of oak lactone isomers

A new total synthesis of the nature-identical enantioners of *cis*- and *trans*-oak lactone has been achieved. The oak lactones, and particularly the *cis*-isomer are among the most important of all wine flavour compounds, imparting vanilla, coconut and enhanced fruit aromas to wines. We have previously reported a synthesis of nature-identical *cis*-oak lactone of more than 85% purity via an open chain glucoside, and determined an aroma detection threshold of this sample in a white and red wine. However, the corresponding sample of the *trans*-isomer was of insufficient purity for sensory evaluation.

Our successful total synthesis of pure *cis*- or *trans*-oak lactone took advantage of the chemistry of 1,2-dioxines which has proven to be extremely fertile. By the judicious use of optically active (chiral) malonate diesters, a substituted dioxine was converted into a pair of diastereomers, differing in the stereochemistry at the ester. Separation of the two diastereomers was comfortably achieved by silica gel chromatography. The individual isomers, now separated, were decarboxylated to give either a *cis*- or a *trans*-substituted product, depending on the decarboxylation method used. Classical chemical techniques were then used to convert these products to the desired oak lactones. Chiral GC analysis confirmed that the nature-identical *cis*-isomer was completely free of its *trans*-counterpart, and *vice versa.* Furthermore, this analysis confirmed that the individual isomers were in a very high state of enantiomeric purity (enantiomeric excess 98%).

The benefit of this synthesis is the fact that all four possible isomers of oak lactone can be prepared from the one original reagent. Using a chiral malonate allows separation of the isomers of an intermediate, and from that point on, one of the separated isomers of this intermediate provides the nature-identical form of *cis*- and *trans*-oak lactone, while the second isomer provides the non-natural forms.

An aroma detection threshold determination of all of these isomers in red and white wine is currently underway. This new synthetic methodology provides an avenue to the production of larger quantities of these compounds, enabling a more detailed descriptive analysis and consumer sensory study.

Wine quality and consumer preference: development of tools to understand market preferences and shifts

Staff

Leigh Francis, Kate Lattey, Belinda Bramley (since October 2004), Sally Kollmann (since May 2005)

Collaborators

Rebecca Bleibaum, Tragon Corporation (USA), Leslie Norris, FlavorSense (USA)

There are many factors that influence consumers in their wine purchase decisions. While this project is mainly directed at sensory aspects that affect consumer preference such as aroma and flavour characteristics, we are also interested in the influence of other variables such as packaging on consumer choices. Recently, a study has been completed which assessed the relative importance of closure type to consumers, compared to wine price, region of origin and grape variety. This has been a collaborative investigation with the USA-based Tragon Corporation, a major marketing research and consulting firm specialising in sensory evaluation, with a key aim of the project being a comparison of the attitudes of USA and Australian white wine consumers.

In early 2004, Rebecca Bleibaum of Tragon carried out a choice based study with around 300 US consumers, and this was repeated by Kate Lattey and Belinda Bramley in Australia with approximately 400 consumers tested in four capital cities: Perth, Adelaide, Sydney and Melbourne. The test protocol followed was closely similar between the two countries, but there were some variations tailored for the local situation. The consumers recruited were asked to select the white wine they were most interested in purchasing from three alternative descriptions. This was repeated in a series of questions, with the combinations tested involving price, variety, region and closure options. The various combinations were presented according to a planned experimental design, so that the effect of each of the factors studied on the consumers' choices could be evaluated statistically. This type of approach is termed a conjoint study and the results give information about the degree of influence on choice of the various factors under test. We also obtained information about the consumers' background, such as their degree of knowledge regarding cork taint, number of years drinking wine, and the price they would normally pay for wines.

The results showed that USA and Australian consumers had quite different responses, with the consumers from the USA being much more strongly influenced by closure type than the Australian consumers, who overall showed that price was by far the major determinant on purchase interest (Figure 1). For US consumers, of the closure choices offered, natural cork closures were of greatest importance, followed by synthetic closures, with screw cap being a strong negative factor regarding whether a wine would have been purchased. For Australian consumers

natural cork had the most positive influence of the three closures, but only marginally more than screw cap, with synthetic cork being a substantial negative influence on choice. Breaking the data down into groups of consumers, for the Australian situation there was a large group—notably those who spend greater than $15 on a bottle of wine, and also those who had been drinking wine for less than ten years—where the screw cap was of equal or greater positive influence on purchase intent compared to the natural cork. In contrast, for the US situation, there was no group of consumers who preferred screw cap closed wines.

This study provides convincing evidence that consumers in Australia, with a longer history of screw cap use especially for premium white wines, are much less influenced by any possible negative connotations of screw caps. Most Australian companies exporting wine to the US would be aware of this difference in perceptions between the two populations, but the results of this study reinforce the need for careful risk assessment by wine companies considering exports to the US under alternative closures.

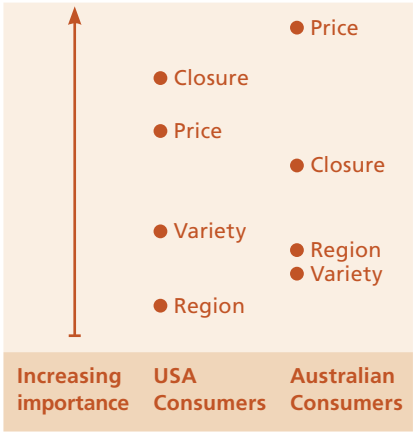


Figure 1. Average importance values for USA and Australian consumers for the four factors tested in the choice-based conjoint study

Sensory analysis at the AWRI

Sensory evaluation activities at the AWRI over the last several years have been administered and largely run by the specialist sensory team. The function of the sensory team has been to plan and carry out studies, involving application of specialist knowledge of appropriate sensory testing methodology; adaption and application of the computerised data acquisition software; and data analysis. In addition, a major role has been to coordinate the various demands on panels and the tasting booths by scheduling assessments and maintaining a pool of trained assessors. Most current research projects at the AWRI involve a sensory component, and numerous external wine industry clients through the AWRI's Analytical Service and AWRI's Industry Development and Support sections have also been provided with sensory evaluation information by the sensory team working with our highly experienced panellists.

Over the last twelve months, there have been 107 individual wines assessed by our technical panel for the presence of taints or faults for Industry Development and Support clients (this is often as part of an investigation of the chemical identity of possible off-flavours), and 80 wines for Analytical Service clients. Sets of bottled wine (from six to 48 individual bottles) have been assessed over the year for the incidence of taints or faults: 18 different sample sets for Industry Development and Support clients, and 10 for Analytical Service clients. Difference tests have also been commonly carried out for industry clients: 35 comparisons in total through Analytical Service over 12 sessions. Contract research projects, also through Analytical Service, have had a considerable sensory component, notably the large commercial closure trial assessing a range of closures for different suppliers or manufacturers, at 24 and 31 months post-bottling, and also other, smaller scale shelf life studies involving other packaging materials.

Major sensory descriptive analysis or difference testing studies have been completed as part of the research programs, reported elsewhere, and have included studies with the research teams of 'Wine and oxygen' (red wine closure studies at 24 months post-bottling, and ascorbate/closure studies on Riesling and Chardonnay at five years post-bottling); 'Interactions of non-volatile and volatile compounds in wine' (model wine study, and effect of bentonite processing); Industry Development and Support closure trial at 63 and 72 months post-bottling; and the volatile thiols yeast project (honours project of Alana Hill-Ling, and a study assessing the effect of yeast on Sauvignon Blanc aroma).

In addition, a range of collaborative sensory analysis activities were carried out with personnel and tasters from outside organisations, such as Allen Hart of Southcorp Wines (red wine and sparkling red wine studies); Kerry Thompson, Audrey Lim and Alex Sas of The Hardy Wine Company (Leasingham Clare trial from the tannin project, and McLaren Vale and Padthaway red wine investigations); John Consadine of University of Western Australia and Richard Rowe of Evans and Tate (Margaret River Chardonnay project); and Jane Paull, Tony Hoare and Libbie Tassie of the McLaren Vale Shiraz benchmarking project.

The sensory team are also heavily involved in working with our Industry Development and Support colleagues to run the Advanced Wine Assessment Course: the most recent course was co-administered by Kate Lattey and Narelle Cream, under the direction of Peter Godden.

Finally, numerous on-going panel training and performance assessments have continued to occur. There have been many facets to this activity, such as recently determining the aroma detection threshold of TCA in a red wine base for nine of our panellists involved in taint and off-flavour assessment. The thresholds for TCA varied among the assessors from less than 1 ng/L (three assessors) to 2.8 ng/L (two assessors). Testing was carried out with six triangle tests at each of six concentrations for each assessor.

Identification, measurement and enhanced control of non-volatile phenolic compounds responsible for colour and mouth-feel of wine

Staff

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This project is part of the CRC for viticulture.

The 'Tannin project' has the long-term objective of understanding how viticultural and winemaking practices affect colour, mouth-feel and flavour characteristics of wine. Our research aims to unravel structures and functions of non-volatile phenolic compounds in wine and involves three broad areas: the development of analytical techniques to efficiently measure non-volatile phenolic compounds in grape and wine samples; the identification of wine compounds that contribute to colour and mouth-feel of red wine; and finally studies into parameters which impact on grape phenolic compounds during winemaking and ageing.

Analysis of phenolic compounds

Research into analytical methods to measure phenolic compounds in grapes and red wine has continued as a priority for the team. In addition, we provided analytical support to various viticultural, winemaking and research projects at the AWRI, and assisted clients from the wine industry, other research organizations and service providers. Using HPLC analysis of grape and wine anthocyanins, tannins and pigmented polymers to generate reference data, the successful co-operation with the NIRS Team to develop techniques for the rapid determination of phenolic compounds was continued (AWRI publications #769, #819).

To address industry demand for a specific tannin measure we have reviewed the various analytical methods (AWRI publications #823 and Herderich, M.J. and Smith, P.A. [2005] Analysis of grape and wine tannins: methods, applications and challenges. Australian Journal of Grape and Wine Research 11, 205-214) and decided to develop and validate a robust and simple assay based on a precipitation protocol. The method relies on UV spectroscopy to determine total tannin concentration in

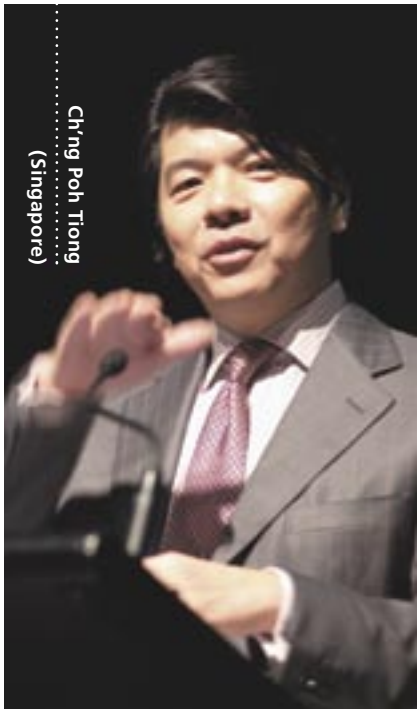
grape homogenate extracts and wine samples. In collaboration with industry partners we applied the tannin assay for the first survey of tannins in Australian vineyards. The data from approximately 300 grape samples demonstrated the substantial range of total grape tannin concentrations in grapes from Cabernet Sauvignon, Merlot, Petit Verdot, Ruby Cabernet and Shiraz, even when measured in grapes showing only minor variation of grape colour. Particular note was made of the large variability in grape tannin levels for Cabernet Sauvignon. Optimisation and validation of the tannin assay continues, and we have participated and assisted in coordinating an inter-laboratory proficiency and validation test with industry partners.

Isolation and characterisation of grape and wine tannins

For the first time MLCCC was used to successfully fractionate three commercially available oenotannins. As part of this research a quaternary solvent system employing acetonitrile, butanol, ethylacetate and water was selected after screening a wide range of solvent combinations. From the preliminary data it is clear that tannins show differences in their solubility, and that these solubility properties can be used to fractionate tannins. Also with the help of MLCCC and a solvent gradient, anthocyanins and acetylated, caffeoylated and coumaroylated anthocyanins have been separated on a preparative scale (AWRI publication #760).

To characterise red wine tannins a 2003 Shiraz wine was loaded on a Sephadex column and phenolic compounds were sequentially eluted with aqueous ethanol and acetone. The fractions were subjected to acid-catalysed depolymerisation in the presence of phloroglucinol followed by HPLC-MS analysis. This experiment demonstrated the diversity of pigments and tannins found in red wine. Also it was shown that the elution profile of wine tannins was very complex. The data made it clear that the methods we have available at present are allowing only limited conclusions as to the structures of the majority of polymeric phenolic materials from red wine. Furthermore, the analytical data did not explain the apparent differences between the wine tannin fractions. Consequently the development and application of methods for the purification and characterization of wine tannins remains a priority and it is planned to progress and strengthen this avenue of research in the future through the appointment of Dr David Jeffery.

In collaboration with Dr Michael Perkin's natural products chemistry research group at Flinders University, Eric Dennis has initiated his PhD research with focus on the organic synthesis of condensed tannins. With this project we are exploring various approaches to obtain structurally-defined compounds for tannin research. An orthogonal strategy for protection and activation was successfully adapted and refined to synthesize condensed tannins from (epi)catechin monomers. So far, limited amounts of some oligomeric tannins have been obtained.


Ch'ng Poh Tiong (Singapore)

Identification of red wine pigments

Analysis of the mass spectra of wine tannins isolated from a three-year old Pinot Noir wine has revealed that some 'pigmented polymers' were the products of direct condensation of anthocyanins with proanthocyanidins. This research has demonstrated the structural diversity of 'pigmented polymers' and identified various tannin-anthocyanin conjugates which were formed by different types of linkages. Conditional on the chemical structures as predicted by the mass spectrometry experiments, it is most likely that some of these modified tannins remain colourless despite inclusion of anthocyanins, while others represent red coloured 'pigmented polymers' (AWRI publications #743, #783). In addition to such directly linked anthocyanin-tannin conjugates, data from winemaking trials and model experiments have highlighted the role of acetaldehyde as a contributor for the formation of pigmented polymers from tannins and anthocyanins (AWRI publication #782).

With the help of electrospray ionisation-tandem mass spectrometry we have completed studies of polar polymeric pigments and could describe for the first time the presence of small amounts of oligomeric anthocyanins in grape skin extracts and red wine (AWRI publication #808). The detection of these oligomeric anthocyanins in grape skin extract is of great interest and further research is warranted to determine their impact on wine colour and organoleptic properties, and to study their role as putative markers of grape quality.

Effects of viticultural treatments and winemaking practices on red wine colour and tannin levels

Cabernet Sauvignon wines covering 51 consecutive vintages from 1954 to 2004 have been thoroughly analysed, including full spectral and colour analysis, and anthocyanins, pigmented polymers and tannins by HPLC. This is the first time the Tannin Project team has studied such a comprehensive set of old wines where the analytical data can be interpreted in view of vintage, winemaking and quality data. The chromatograms confirm that anthocyanins are only present in younger red wine and have disappeared almost completely after five years of storage. Some of the older wines retained their intense red colour properties in the absence of anthocyanins; this emphasizes the limited contribution of anthocyanins to red wine colour. Pigmented polymer and tannin concentrations fluctuated from vintage to vintage, however, and as opposed to anthocyanins, no significant decline could be observed. The pyranoanthocyanin, Pinotin A, which has been proposed as a chemical marker compound to assess the age of red wine, was detected only in some wines from the 1970s.

Distinct effects of seed components and/or varied anthocyanin/tannin ratios on wine composition and sensory properties may occur if there were differences in berry size between treatments and we are investigating this aspect in Cabernet Sauvignon in a study as part of the CRCV 'Tannin Project' with Dr Patrick Iland and Leasingham Wines. Sensory data for the 2004 wines were obtained from a panel of Hardy Wine Company winemakers using a descriptive analysis approach. The sensory study showed that for wines made in 2004 high quality related to low sourness and acidity, coarseness, and spicy aroma, and high ratings for fruit concentration, palate weight, mouth-coating, and overall fruit and floral aroma. Red wine from one particular pruning treatment was rated lower in quality, while irrigation treatments also had an effect. In 2005, a total of 306 grape samples were collected at veraison, pre-harvest, harvest and post-harvest. All samples have been analysed for maturity measures, and grapes have been sub-sampled for comprehensive colour and phenolic analysis. Replicated mini-lot ferments of grapes collected at harvest and pre- and post- harvest for all six treatments (three pruning and two irrigation levels) have been completed and the data are currently being analysed.

Improving microbial performance, wine diversity and wine quality

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In 2005, the former Molecular Biology and Microbiology groups at AWRI were merged into a single Biosciences Group; with a focus on 'Improving microbial performance, wine diversity and wine quality'. This merger formalised changes that had occurred over the preceding year during which several staff had left and four new staff commenced. These new positions provided the unique opportunity to restructure the research program. The current research and the interests of the group include: the generation of yeasts and bacteria that confer improved wine sensory properties; improved stress tolerance of wine yeasts and malolactic bacteria; production of new wine yeasts using non-GM approaches, such as interspecies hybridisations; development of 'low alcohol' yeasts and development and commercialisation of wine microorganisms. The following is an overview of some of the major activities of the Biosciences Group.

Flavour-active yeast

Through fermentation, yeast catalyse a dramatic transformation of relatively low flavoured grape must into wine with a large array of vinous and varietal flavour compounds. In our continuing program of research to understand better how yeast catalyse these flavour changes we have focused on two main areas, namely the formation of the fruity esters and thiols, and the hydrolytic release of varietal flavour substances from flavourless grape precursor compounds.

For convenience we can consider grape must to contain three functional groups of potential flavour compounds, namely 'precursor flavour-active compounds', 'non-precursor flavour-active compounds' and 'nutrients' (Figure 2). *Biotransformation of nutrients:* in addition to the major pathway of sugar fermentation to ethanol and CO_2, yeast metabolism also produces volatile compounds, such as esters, higher alcohols, aldehydes and ketones, volatile fatty acids and thiols (hydrogen sulfide and mercaptans), which contribute to the generic 'fermentation bouquet' of wine. *Non-precursor flavour-active compounds:* some grape-derived compounds, such as some carboxylic acids and phenolics, and aroma volatiles, such as methoxypyrazines, remain unmodified during fermentation. *Biotransformation of precursor flavour-active compounds:* non-volatile precursor compounds from grapes, such as glycosides and cysteine-conjugates, are hydrolysed by yeast hydrolytic enzymes, whereas compounds such as some monoterpenes and phenolic acids undergo biotransformation reactions and yet other compounds, such as anthocyanins, react with yeast metabolites (carbonyls) to form modified compounds with new sensory properties. The grape-derived compounds, many of which are non-volatile and flavourless, after fermentation contribute to wine varietal aroma and flavour, appearance and mouth-feel. These reactions, biochemical mechanisms and flavour implications have recently been the subject of two comprehensive reviews: Swiegers, J.H. and Pretorius, I.S. (2005) Yeast modulation of wine flavour. *Advances in Applied Microbiology* 57, 131-175; and Swiegers, J.H., Bartowsky, E.J., Henschke, P.A. and Pretorius, I.S. (2005) Yeast and bacterial modulation of wine aroma and flavour. *Australian Journal of Grape and Wine Research* 11, 139-173.

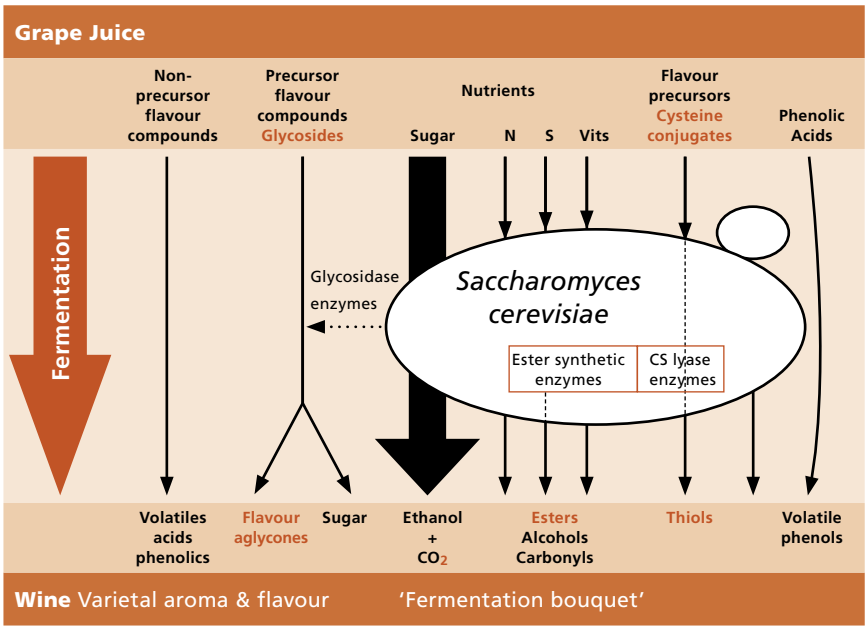


Figure 2. Biotransformation routes by which grape precursor and non-precursor flavour compounds and nutrients contribute to wine appearance, aroma, flavour and mouth-feel. The compounds subject to current research are highlighted in red ink

Thiol and ester formation

Wine yeasts are involved in the biosynthesis and modulation of two important groups of aroma compounds in wine; volatile thiols and esters. These compounds impart aromas and flavours such as cherry, blackcurrant, banana, rose, pear, passion-fruit, grapefruit, guava and gooseberry, to name but a few. We are particularly interested in these high-impact flavour compounds and, over the past year, have made exciting advances. For example, we have learnt a great deal about the role that wine yeasts play in the production and release of volatile thiols from grape juice and, more recently, about yeast-driven ester formation during fermentation.

A major focus has been the volatile 'fruity' thiols, 4-mercapto-4-methylpentan-2-one (4MMP), 3-mercaptohexanol (3MH) and 3-mercaptohexylacetate (3MHA). These compounds have extremely low detection thresholds (as low as 1 ng/L) and impart passion-fruit and grapefruit aromas to wine, and if present at high concentrations, box tree and cat urine aromas. Although they have been identified in a large variety of wines including Cabernet Sauvignon, Merlot, Riesling and Semillon, they are of particular importance in determining the varietal character of Sauvignon Blanc.

Research has shown that 4MMP and 3MH are found in grape must as non-volatile, flavourless, cysteine-bound conjugates and are released during fermentation by the action of wine yeast. However, less than 5% of these precursors in must are converted to flavour-active volatile thiols during vinification. Therefore, the rather limited action of yeast leaves a huge reservoir of aroma and flavour compounds trapped in wine. This led to work being initiated to elucidate the genetic components involved in volatile thiol release. A number of putative carbon sulfur lyase-

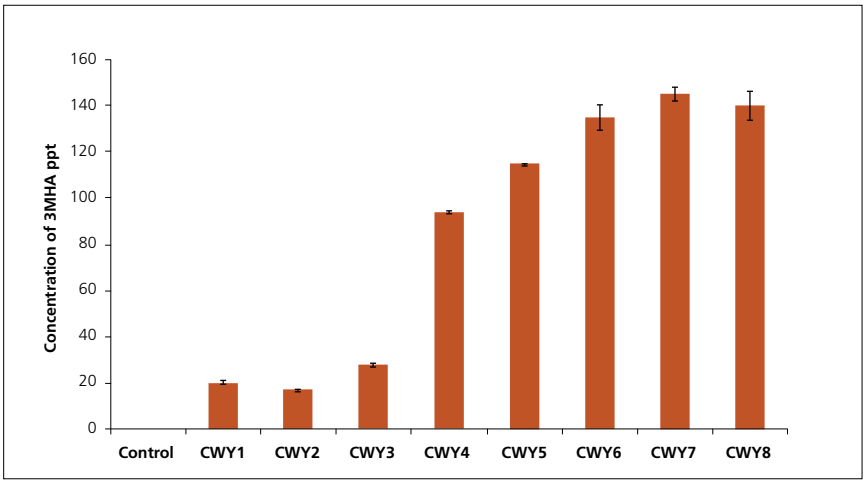


Figure 3: The capacities of a range of commercial wine yeasts (CWY1 – CWY8) to transform 3MH to 3MHA.

encoding genes were identified based on their homology to existing carbon sulfur lyases. Using a laboratory strain of yeast, four of these were shown to influence the release of 4MMP, indicating that the underlying mechanism of volatile thiol release may involve multiple genes. Deletion of the same genes in a homozygous derivative of the commercial wine yeast, VL3, confirmed their importance in this process. Interestingly, a yeast strain with a deletion in one of the four carbon sulfur lyases, *YAL012w,* was found to produce increased levels of another thiol, 2-methyltetrathiophen-3-one (MTHT). While this compound had previously been shown to contribute to wine aroma, its source was unknown. The increased level of its production by the *yal012w*Δ strain relative to the parent suggests a role for yeast in the turnover of this aroma compound (Howell et al. [2005], Appl. Environ. Microbiol. in press).

Although the volatile thiol 3MHA has been identified in a number of wines, the cysteine conjugate precursor was unknown. We postulated that 3MHA might be formed by a yeast-driven esterification of 3MH. This was tested by over-expressing, in a wine yeast background, a number of genes encoding enzymes involved in ester metabolism, and assessing their ability to produce 3MHA from 3MH. From this work it was found that wine yeast does indeed convert 3MH into 3MHA. More importantly however, over-expression of one of the genes that were transformed into the wine yeast resulted in a seven-fold increase in the amount of 3MHA produced. This suggests an important role for the product of this gene in modulation of volatile thiol levels in wine. Interestingly, over-expression of the same gene in a laboratory yeast resulted in a 50-fold increase in the amount of 3MHA formed (Swiegers et al. [2005] Proceedings of the Weurman Flavour Research Symposium, Roskilde, Denmark; to be published in the book: Flavour Science of Foods and Beverages, Elsevier). Furthermore, in a comparative analysis of a range of wine yeasts there was a large variation in the level of 3MHA that they produced, indicating that there is a genetic basis to the potential for yeast-driven volatile thiol production from grape must (Figure 3).

Glycosidic precursor of flavour-active compounds

Grapes contain a large pool of potential volatile flavour-active compounds that are mainly constituted as odourless, non-volatile glycoconjugates. Several classes of compounds are typically present as glycoconjugates, and include monoterpenes (such as linalool and geraniol which impart floral aromas), norisoprenoids (such as ß-damascenone which imparts a honey fruity aroma), aliphatics (such as hexanol which gives a green flavour), benzene-derivatives (such as raspberry ketone) and phenols (such as anthocyanins which contribute to red wine colour). An estimate of the glycosidic fraction is provided by the Glucosyl-Glucose (G-G) assay previously developed by the AWRI. G-G analysis of grape juice correlates with wine flavour intensity and wine quality score thereby providing a useful measure of potential flavour (AWRI publications #607 and #703). It was observed that the G-G decreased during fermentation, but the mechanism of glycoconjugate hydrolysis is not well understood. In order to control this step during fermentation information on the mechanism of hydrolysis is needed. One step towards determining the mechanism has been undertaken with a model fermentation study. This project was undertaken at the AWRI by a visiting PhD student, Maurizio Ugliano from Foggia, Italy with support from an Italian Government scholarship and the University of Foggia. He successfully completed his studies and was awarded a PhD degree in March 2005.

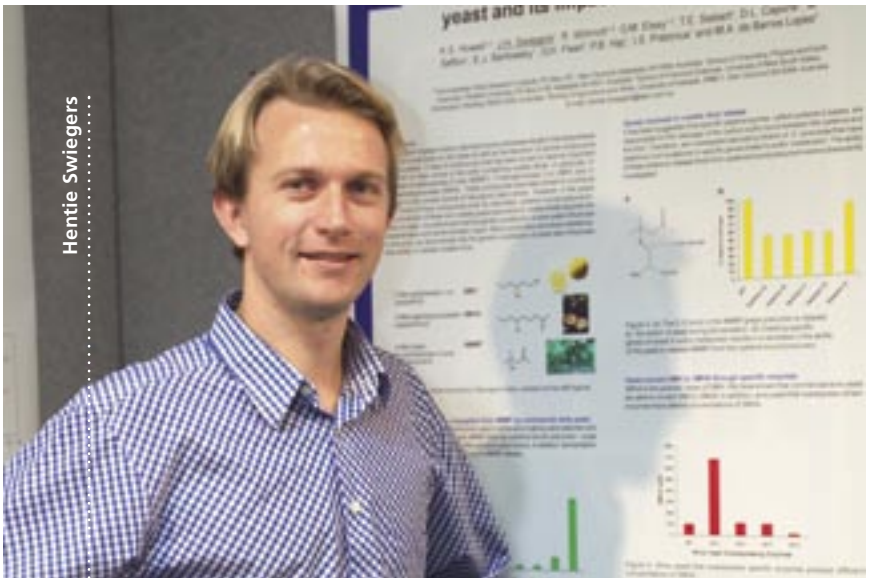
The glycoconjugate fraction was extracted from a floral grape must and introduced into a chemically defined grape juice-like medium to study the hydrolysis of the grape glycosides. A part of the medium was kept free of yeast while other samples were inoculated with two *Saccharomyces cerevisiae* strains and one *Saccharomyces bayanus* strain. After fermentation, the aglycones were extracted from the wines and their identity established by GC-MS using techniques well established at the AWRI. Non-fermented synthetic grape juice containing glycosides was also extracted and analysed in order to determine the proportion of non-enzymatic glycoside hydrolysis.

Fermentation resulted in a marked increase in the concentration of a number of volatile compounds compared to the unfermented control. Since a synthetic grape juice devoid of natural glycosides or their products was used, we can conclude that these compounds must have arisen by hydrolysis of the added glycosides. The increase of volatiles due to non-enzymatic hydrolysis of glycosides was lower than that associated with alcoholic fermentation. These results suggest that yeast can actively contribute to the process of transformation of non-volatile precursor forms into volatile compounds during fermentation while chemical hydrolysis of glycosides plays a minor role in the hydrolysis of glycosidically bound volatile compounds. It was further observed that the choice of yeast impacted on production of some volatiles. Although too few strains were studied to make a generalisation, if this effect is validated, then the possibility of selecting strains with different profiles could, in the first instance, provide a means of modulating the compounds liberated. Finally, the presence of citronellol in these wines indicate that yeast has the ability to transform some aglycones following their release from glycosides.

Further research, which was conducted by Professor Carrau and colleagues at the Montevideo University, Uruguay (Carrau, F.M., Medina, K., Boido, E., Farina, L., Gaggero, C., Dellacassa, E., Versini, G. and Henschke, P.A. [2005] De novo synthesis of monoterpenes by *Saccharomyces cerevisiae* wine yeasts. FEMS Microbiology Letters 243, 107–115) has shown that citronellol can be derived by *de novo* synthesis from lipid metabolism of some yeast strains. This work demonstrated that nutrients, oxygen and nitrogen, can affect the formation of monoterpenes, such as citronellol.

Flavour-active and stress-tolerant bacteria

The main objectives of the bacterial research program are to understand and improve the induction of malolactic fermentation (MLF) and to understand better the modifications that MLF make to wine flavour and how to manage better these changes. The management of acetic acid bacteria (AAB), which are important wine spoilage organisms, is also studied in this program. MLF is an important bacterial process in the making of red wine, several white wine varieties and an increasing number of sparkling wines. Not only does MLF decrease the acidity of wine, but it offers winemakers another tool to enhance the aroma and palate of a wine. Both of these aspects have formed a part of recent research projects; the role of MLF in bio-deacidification and its influence on the palate, as well as on wine aroma were summarised in the Annual Report for 2004 and presented at the 12 AWITC held last July.


Hentie Swiegers

As indicated above, glycosides represent a pool of non-volatile flavour precursor compounds that potentially contribute to the varietal character of wine. Many of these glycosidic precursors are hydrolysed during alcoholic fermentation by yeast. Malolactic bacteria, such as *Oenococcus oeni* are also capable of hydrolysing glycosides which can contribute to wine sensory properties. Previous work has demonstrated the ability of *O. oeni* to release a group of chemically different compounds from Chardonnay wine glycosides (AWRI publications #762 and #770). The design of the experiment allowed us to establish that *O. oeni* can exhibit at least two other glycosidase activities, an α-L-arabinosidase and α-L-rhamnosidase in addition to β-glucosidase. This work has further demonstrated that these glycosidases are active against authentic wine glycosides as well as synthetic model glycosides. Extending this research, Vincent Bouyer, a visiting Masters of Biological Engineering student from Université de Technologie Compiègne, France studied the hydrolysis of several newly synthesized glucosides by lactic acid bacteria in a model system. The glycosides had been synthesised by Dr Mark Sefton and his team at the AWRI. With his research, Vincent demonstrated that both *O. oeni* and several *Lactobacillus* strains, commonly associated with wine, could liberate geraniol from its synthetic glucoside. Geraniol exhibits a rose-like geranium aroma in wine, which is important to the floral wine styles. Limited release of geraniol was also observed by several yeast strains.

AAB species are not welcome during grape vinification and a small, but important part of the bacterial research program examines the ecology and physiology of these wine spoilage bacteria. Recent research describing the role of AAB in microbial induced oxidative spoilage of bottled red wine and ways to avoid spoilage was summarized in AWRI publications #718 and #778, and presented at the inaugural international symposium on Acetic Acid Bacteria, held in Italy in April 2005.

Two workshops on malolactic fermentation were convened during the 12 AWITC (see Appendix 1). The workshops featured practical talks by researchers and winemakers and tasting of experimental wines made with a variety of malolactic bacteria. The workshop provided the latest views on, and demonstrated the potential of, malolactic fermentation for building wine style and flavour complexity.

Low-ethanol yeasts

One of the advantages of wines made from grapes grown in warm climates is the potential for creating rich, full bodied wines with exotic flavour profiles. These characteristics result, in part, from the maturity of grapes when they are picked; more mature grapes generally deliver greater complexity in flavour. However, a warm climate and lengthy ripening translates into high sugar levels in grapes, and this, in turn, leads to wines with higher levels of alcohol. High alcohol content is not necessarily a negative attribute but it can compromise the flavour of a wine, lead to increased costs in the form of higher taxes, and there are health issues associated with excessive ethanol consumption. This has led to a push to develop strategies for reducing the ethanol content of wine, without compromising sensory properties.

Ethanol reduction can be achieved using processes that remove alcohol after the wine is made, but these approaches can be expensive and may impact on wine flavour. Picking grapes before sugar levels are too high or removing sugars from must before fermentation are other possibilities but these again compromise wine flavour. An alternative strategy is to persuade wine yeasts to make products other than ethanol from grape sugars, and this is the approach that we are taking. Scientists at AWRI and in other laboratories have used gene technologies to produce variants of yeast with targeted alterations in sugar metabolism. This work has demonstrated that breakdown of sugars can be diverted away from ethanol production to making other end products such as glycerol. While these experimental yeasts are not destined for use in commercial winemaking, they have been very useful for testing the concept that low alcohol wine can be made by diverting yeast metabolism; making more glycerol at the expense of ethanol, for example, turned out to be feasible. Work on this project has benefited significantly from the input of Danie Malherbe, a visiting PhD student from Stellenbosch University (South Africa).

The challenge ahead is to develop 'low-alcohol yeasts' using traditional breeding and selection processes that are acceptable to the consumer. When we breed yeasts to make novel strains we generally have to apply a selection pressure that will favour the characteristic we are trying to breed into the strain. Finding a selection pressure that favours low ethanol production is not straightforward, but we are currently testing a promising strategy that has the potential to enable us to accomplish this challenging goal. This work is being done in collaboration with Associate/Professor Grant Stanley (Victoria University, Melbourne), and a PhD student from the same university, Dariusz Kutyna, who has recently joined the group at AWRI.

Stress-tolerant wine yeasts

The major focus of this project is to improve our understanding of factors which influence tolerance to ethanol-stress in yeasts. This is of importance to the wine industry because accumulation of ethanol during fermentation has been identified in the scientific literature as a contributor to stuck and sluggish fermentations, leading to incomplete utilisation of sugars in grape juice. Although all strains of *Saccharomyces cerevisiae* used in wine production have high levels of ethanol tolerance compared to other yeasts, some wine yeast strains are more tolerant than others. This indicates that there is a genetic component to stress resilience, although the genes involved have yet to be defined.

We are currently taking two approaches to improve our understanding of yeast tolerance to ethanol stress. One of these is being done in collaboration with Associate/Professor Grant Stanley (Victoria University, Melbourne) and Dr Miguel de Barros Lopes (University of South Australia, Adelaide) and is being carried out by a PhD student, Tina Tran. Using adaptive evolution, Tina is attempting to identify and characterise genes that confer improved ethanol tolerance on spontaneously and chemically induced mutants of a laboratory *S. cerevisiae* strain. In parallel, we are applying adaptive evolution to raise wine yeast strains with increased ethanol tolerance. Such strains will be of direct benefit to the industry and will provide a means of furthering our understanding of ethanol-tolerance.

Nutrient management deriving fermentation

Yeast derive all their nutrients from grape juice/must for growth and fermentation activity unless supplements are added by the winemaker. Nitrogen, in the form of amino acids and ammonium, is generally a limiting nutrient under Australian conditions and a deficiency is associated with stuck fermentations and sulfide formation. Nitrogen deficiency is

corrected typically by adding nitrogen in the form of diammonium phosphate (DAP) or proprietary products. Further information on this topic has been summarised as part of a larger review on the 'Impact of nitrogen on grapes, fermentation and wine' in collaboration with Dr Sally Bell (Bell and Henschke, submitted 2005).

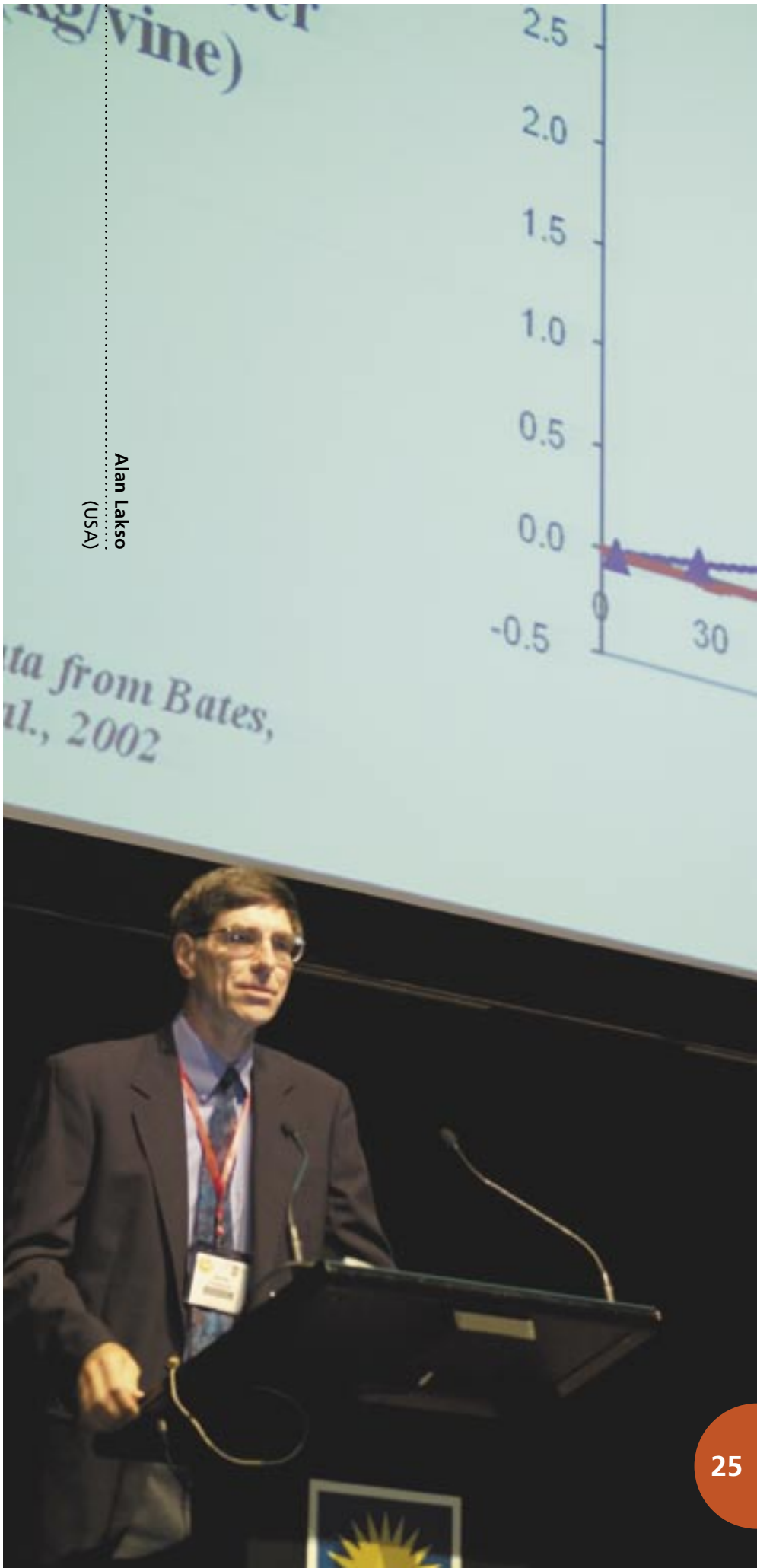
Recently, Dr Diego Torrea demonstrated that DAP also has a major impact on wine aroma as determined by quantitative sensory descriptive techniques carried out by Dr Leigh Francis' sensory team (poster presentation, 12 AWITC in Melbourne 2004, see Appendix 1). Dr Torrea found that suboptimal concentrations of nitrogen (160 mg/L) led to wine showing undesirable aromas whereas high nitrogen (320 mg/L) produced an aroma of volatile acidity. The optimal level of nitrogen required for the most preferred aroma profile of Chardonnay wine using a high nitrogen requiring yeast (AWRI 796) was approximately 300 mg/L of yeast assimilable nitrogen (YAN).

In order to establish whether the optimum level of nitrogen varies with different strains of yeast and juices of different composition, a series of experiments has been conducted by Dr Mar Vilanova. She worked at the AWRI as a visiting scientist from Consejo Superior de Investigaciones Cientificas, Spain, being supported by a Spanish Government postdoctoral fellowship for a period of just over three months. Two yeast of different nitrogen demand and media with a wide range of nitrogen concentrations have been selected for the project. The fermentations have been completed and extracts of the wines have been subjected to GC-MS analysis to determine the profile of wine aroma compounds produced by the yeast.

Saccharomyces bayanus and other novel wine yeasts

Vintage trials have continued with the *Saccharomyces bayanus* strains. It is noteworthy, that one company (St Hallett Wines) released the first commercial wine in 2004 using one of these strains and a blended wine, made with a *Saccharomyces bayanus* component from the 2005 vintage, has been awarded a gold medal. A presentation and review article on the winemaking properties of the AWRI *Saccharomyces bayanus* strains have recently been prepared for publication (Eglinton et al. 2005, submitted).

Three workshops on novel wine yeasts were convened during the 12 AWITC (see Appendix 1). The workshops, which featured practical talks by yeast researchers and winemakers, tasting of experimental wines made with a variety of novel yeasts, and a blending exercise to demonstrate the potential of these wines for building wine complexity, has increased further awareness and interest in novel yeasts. Technical information and wines related to the AWRI experimental yeasts *S. bayanus* strains, several *Candida* species and the *Saccharomyces* sensu stricto hybrids were presented for evaluation.



Alan Lakso (USA)

The AWRI culture collection

Staff
Eveline Bartowsky and Jane McCarthy

The AWRI bacteria and yeast culture collection currently contains over 1000 strains (340 bacteria and 740 yeast) and is managed by Dr Eveline Bartowsky. The bacteria and yeast strains in the collection include reference strains, winery isolates, and research and experimental strains. This microorganism collection is an important and valuable resource for the AWRI and the Australian wine industry. Wineries can deposit their cultures in the AWRI culture collection and request slopes at any time. We are currently incorporating the latest molecular-based techniques to identify strains to the genus and species level, and to distinguish strains within a species. This is an on-going process which will be continually expanded and improved.

Encompassed in the culture collection are yeast strains available to the Australian wine industry including eight commercial strains and seven experimental strains which have been developed at the AWRI. Information received from wineries on commercial scale fermentations with the experimental yeast strains augments the AWRI knowledge-base on these cultures, and helps to develop a detailed overview on performance and potential of these yeast strains.

Requests for microorganisms are received from Australian wineries, research institutes (world wide), Australian teaching institutions and commercial companies. Provision of all cultures, except experimental strains, incurs a modest fee to cover materials.

Waite Campus Mass Spectrometry Facility

Staff
Yoji Hayasaka and Gayle Baldock

The three important roles of the Waite Campus Mass Spectrometry Facility are to act: (1) as a leader in the application of mass spectrometry to grape and wine research; (2) as an investigator to solve the problems facing the wine industry and individual wine makers, using mass spectrometric techniques; and (3) as a collaborator with The University of Adelaide, Provisor and CSIRO in supporting research activities involving mass spectrometry.

Mass spectrometry facility usage trends
The Waite Campus Mass Spectrometry Facility provides access to two triple quadrupole tandem mass spectrometers. The TSQ GC-MS/MS and API LC-MS/MS are used for various purposes and a total of 452 samples were analysed by the mass spectrometry facility staff for the period between 1 July 2004 and 30 June 2005. Usage for this period is detailed in the Table 1.

The Waite Campus Mass Spectrometry Facility also operates Provisor's HPLC – iontrap mass spectrometer (ThermoFinnigan LCQ Deca XP Plus) to expand the current mass spectrometric resources and services. The instrument has very versatile HPLC-MS and MS/MS functions and access to this instrument has provided us with opportunities to investigate new techniques and enhance current methods for the analysis of grape and wine constituents.

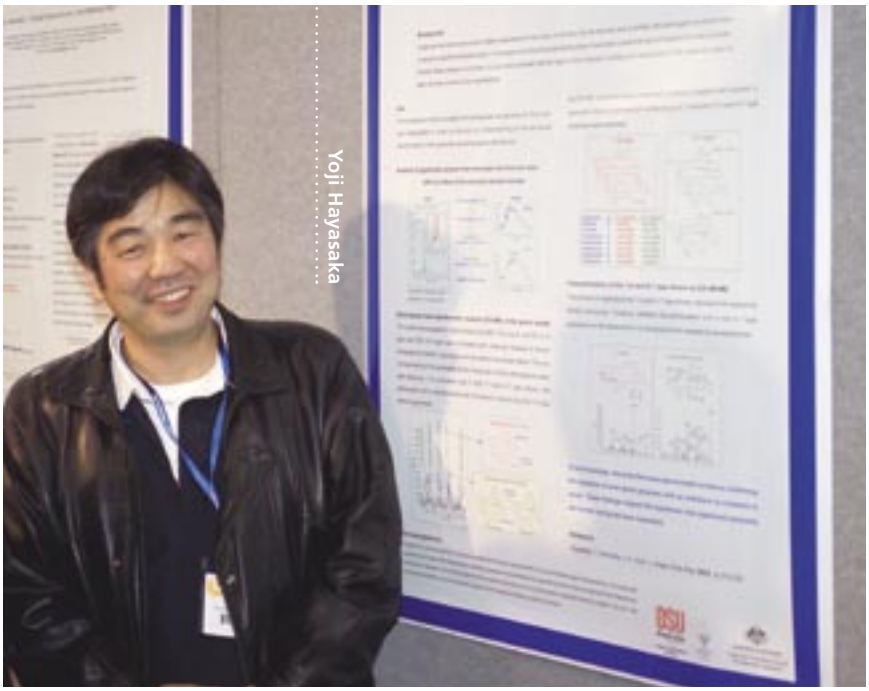

Yoji Hayasaka

Table 1. A comparison of the usage for the TSQ GC-MS/MS and API LC-MS/MS

	TSQ GC -MS/MS	API LC -MS/MS
AWRI	72%	66%
The University of Adelaide	28%	34%

In the reporting period, staff of the facility assisted a wide rage of AWRI projects (50% of AWRI usage of the instruments) and the contribution of the Waite Campus Mass Spectrometry Facility to the research projects are detailed in the respective research team reports. Usage of the facility for activities of AWRI's Analytical and Industry Development and Support Services accounted for 50% of AWRI's usage time.

Collaboration with the Industry Development and Support and Analytical Service teams
The Waite Campus Mass Spectrometry Facility is an essential resource for the wine industry to identify and monitor contaminants in juice or wine samples and, therefore, helps to ensure and maintain the quality of our products at a high standard. In collaboration with staff of the Industry Development and Support and Analytical Services teams, facility staff conducted analyses on 154 samples (compared to 254 in 2003/04) mainly for the investigation of taint or contamination problems. Of these 154 samples, 36% were investigations into potential brine contaminations and 33% were investigations of aromatic hydrocarbons. The analyses conducted during the reporting period are further detailed in Table 2.

Table 2. Problem solving investigations conducted in the reporting period

Type of investigation	Number of samples analysed
Potential brine contamination	**56**
Aromatic hydrocarbon taints – naphthalene 36 – diesel oil 2 – general taint screen 13	**51**
Anthocyanin profiles	**1**
Protein analysis for varietal differentiation	**2**
Hydraulic oil contamination	**5**
Sanitiser contamination	**2**
Chlorophenols	**4**
Unknown chemical/plastic contamination	**32**
Musty taints (geosmin/MIB)	**4**
Total samples	**157**

For some investigations, some method development was also required as follows:

- In cooperation with AWRI's Trace Analytical Laboratory, a method for the detection of musty compounds, geosmin, methylisoborneol and octen-3-one is being developed using GC-MS in SIM mode combined with a SPME technique. The objective is to develop a method that is capable of the detection and quantification of those compounds at their sensory thresholds.

- Also in cooperation with AWRI's Trace Analytical Laboratory the method for the analysis of rhodamine containing brine was modified to improve its sensitivity for the red wine matrix. As a result, the detection limit for brine in red wine has been lowered to 0.0002% which is approximately 10-times better than that of the previous method.

- In cooperation with Chris Curtin, a HPLC-MS method for the analysis of precursors of 'brett' character including coutaric, caftaric, fertaric, coumaric, caffeic and ferulic acids and anthocyanin coumarates has been developed. Subsequently, the new method was successfully applied for the analysis of red wines, white wines and grape homogenates.

Analysis of 2,4-D (2,4-Dichlorophenoxy acetic acid)

In cooperation with Industry Development and Support, Analytical Service and various research teams, methods for the detection and quantification of 2,4-D in grapes and wine have been developed. The methods have been successfully validated and are capable of detecting as little as 0.5 ppb of 2,4-D in wine and grape samples.

As part of the 50th Anniversary celebrations of the AWRI, the contributions of mass spectrometry at The Australian Wine Research Institute to the advances in knowledge of grape and wine constituents have been summarised with a review article by Y. Hayasaka, G. Baldock and A. Pollnitz (Australian Journal of Grape and Wine Research [2005] 11: 188-204).

Wine and oxygen: towards and optimised management of wine manufacturing, maturation and storage

Staff and students

George Skouroumounis, Mariola Kwiatkowski, Leigh Francis, Kate Lattey, Patrik Jones, Liz Waters

Collaborators

Allen Hart, Ian Shephard (Fosters Wine Estates)

Bottling and storage of white wines

We initiated a study in 1999 to determine the effect of ascorbic acid addition at bottling, of closure type, and of storage position and conditions, on composition and sensory properties of wine that are related to wine oxidation and development. Closures studied included a roll on tamper evident (ROTE) screw cap, a synthetic closure, and two natural cork closures. In addition, a small quantity of wine was sealed in glass ampoules. This study was undertaken on two wine types, a Riesling and a wooded Chardonnay wine and the bottles were stored under 'industry best practice' conditions of controlled temperature and humidity.

Over the five years of the trial, the data from this study confirm that wine development is strongly influenced by the choice of closure used to package the wine. By all measures of wine oxidation used in this study and for both wine types, storage under the screw cap resulted in the least oxidative changes with time, a performance matched only by that of the glass ampoules. Use of the synthetic closure resulted in wines with the greatest oxidation in the set at three and four years' storage, as observed in other studies (AWRI publication #666). It is highly likely that these results are related to the degree of oxygen permeability of the closures. In some cases, inverted storage of the natural bark cork closed wines resulted in the wine with less oxidised characters than upright storage, although the influence of storage position was relatively minor. These studies were undertaken under excellent storage conditions in a temperature and humidity controlled storage area (15-18ºC, 60-80%, respectively, without more than a 1ºC change per day). Storage position of bottles might have a bigger impact in a more variable storage environment.

The wines sealed under screw caps or in glass ampoules were rated by a sensory panel as the lowest in oxidation aroma and were also scored relatively highly for a reductive *struck flint/rubber* aroma attribute. This latter character appears to be related to little to no oxygen permeability of the closure/package. It seems highly unlikely to be due to taints arising from, or aroma compounds produced from precursors derived from the screw cap or its wad because it also occurred in wines sealed in glass ampoules. Development of this character might depend on the presence of grape- or fermentation-derived precursors in wine at bottling. It is possible that its development after bottling could be greatly reduced or prevented by winemaking practices before bottling, such as addition of copper sulfate.

Ascorbic acid addition at bottling also had an impact on wine development and generally resulted in wines with less oxidation. In terms of colour, for the Chardonnay wines, the effect of ascorbic acid addition at bottling assessed between two weeks and two years after bottling suggested that wines without addition were browner and had more overall colour intensity. This same result was obtained two and a half years after bottling. For the Riesling wines, ascorbic acid addition appeared to have no significant effect on brownness and overall colour intensity at any storage time although the Riesling wines with ascorbic acid were generally higher in yellow hue.

Ascorbic acid addition to wine at bottling had little effect on wine aroma and flavour when the wines had been in bottle for six months or less and the differences observed are unlikely to be of practical significance. At bottle storage times of three years or more, however, addition of ascorbic acid at bottling generally resulted in wines with no difference in aroma or less oxidised and/or more fresh fruity aromas. For some of the wines the effect was small, but it was particularly pronounced in the synthetic closed wines, and in the Chardonnay wines after five years' storage.

After three years' storage, the concentration of the antioxidant sulfur dioxide was little different or slightly but statistically significantly higher in wines to which ascorbic acid was added at bottling than those without addition. This observation for both wine types does not support the view in the literature that it is necessary to increase SO_2 levels at bottling if ascorbic acid is present. If anything, the data suggest that, in this trial, the use of ascorbic acid under ideal storage conditions complemented the use of sulfur dioxide as an antioxidant, because the wines were less oxidised and slightly less SO_2 was consumed.

Measurements of the absorbance at 420 nm (A420) are normally used to estimate the development of brown colour of wines. In this study, it was noted that when wines with and without ascorbic acid were compared, the A420 measurements did not always correlate with the degree of brownness by visual assessment or by CIELAB instrumental colour measures. Ascorbic acid addition at bottling consistently gave wines with higher yellow colour than wines without the addition. This was determined either visually with a panel of assessors or instrumentally through the CIELAB value b*, which indicates degree of yellow hue. Brown is not a primary colour, but a mixture of red, yellow and blue. It is possible that ascorbic acid may reduce the perceived brownness of wine by reduction of 'pinking' concomitant with increases in yellowness. Thus, in any trial carried out to compare the effect of ascorbic acid on wine development and oxidative change, the A420 value, which is in fact a measure of yellowness, can be misleading.

A more appropriate wavelength to assess brown colour in this situation would be at longer wavelengths, such as 500 nm, to capture information about the red and/or blue tints of wine. It must be noted, however, that within a sample set where the wines did not differ in ascorbic acid addition at bottling, the A420 values correlated well with visually assessed brownness.

Bottling and bottle storage of red wines

Roll-on tamper evident screw cap closures (ROTE) have recently become a popular alternative for Australian and New Zealand white wines and a number of studies undertaken elsewhere and at the AWRI since the seventies have assessed the performance of these closures for white wines (for example AWRI publications #139, 534 and 666, respectively). However, there is less information available on the effect of screw cap closures on red wine development. The objective of a trial undertaken in this project was to gather preliminary information about whether a red wine under screw cap develops more *'reduced' (rubbery, struck flint-like)* aroma, altered colour and chemical properties than under natural cork and to evaluate whether headspace volume under screw cap affects these differences.

A 2002 commercial Cabernet Sauvignon wine was bottled under five different closure parameters: natural bark Reference 2, synthetic closure, and screw cap *Auscap* with different headspace height (ullage volume): 16 mm (4 mL of air), 53 mm (16 mL of air) and 104 mm (64 mL of air). Wine parameters at bottling were typical for a wine of that style. Wines have been stored upright in the Hickinbotham Roseworthy Wine Science Laboratory in a temperature and humidity controlled storage area (15-18^{o}C, 60-80%, respectively, without more than a 1^{o}C change per day).

Informal sensory assessment after six weeks and a formal aroma difference test at six months post-bottling suggested that there were no differences between the treatments up to this time. However, aroma difference testing at nine and a half months post-bottling showed that the wine sealed under screw cap with the largest volume headspace was statistically significantly different from that under the natural bark closure and it was also different from that under the screw cap with the intermediate volume headspace.

Sensory descriptive analysis was conducted after 12 months post-bottling and there were found to be no statistically significant differences among the treatments for any of the attributes rated except *'reduced' (rubbery, struck flint-like)* and *'oxidised' (developed).* The samples were rated on a 0-9 scale, and the highest average score for *'reduced'* was 0.9 for the screw cap wine with the lowest headspace, while for *'oxidised'* the highest mean score was 1.3 for the screw cap wine with the largest headspace. The sensory descriptive analysis was repeated at 18 months post-bottling. At this time point, the wine with the screw cap closure with the smallest headspace was again rated as highest in *'reduced'* aroma, but once again the scores were very low.

The colour of the wines and concentrations of free and total SO_2, pigments, and tannins were monitored throughout the storage period. The wine under the screw cap with the largest headspace contained the least free and total SO_2; this was evident as soon as two days after bottling. Free and total SO_2 concentrations in the wine under the screw cap with the smallest headspace, at all time points, were the highest. The other treatments contained similar concentrations of SO_2. The concentration of malvidin-3-glucoside showed similar trends to that observed for the concentration of SO_2. The concentration of pigmented polymers and tannins and the colour density values showed the opposite trend: all of these parameters were highest in the wine sealed under the screw cap with the largest headspace, lowest in the wine sealed under the screw cap with the smaller headspace and similar in the wines sealed under the natural bark, synthetic and the screw cap with the intermediate volume headspace. The use of CIELab colour analysis of the wines 18 months after bottling indicated that the wine sealed under the natural bark, or synthetic closure, or the screw cap with the intermediate headspace volume were similar in colour. The wine sealed under the screw cap with the largest headspace had darker colour and was more red and more yellow than these three treatments, and the wine sealed under the screw cap with the smallest headspace had lighter colour and was less red and more yellow than these three treatments.

The overall conclusion from the data is that those red wines sealed with a natural bark, a synthetic closure or under a screw cap with the intermediate headspace volume, were all very similar. Only the wines sealed under screw caps with extreme differences in headspace volume (4 mL and 64 mL) showed differences in analytical or sensory parameters, and only time will tell whether those differences have commercial significance. Further data obtained over the next year of the wine's life will shed more light as to whether differences in oxygen level in headspace at bottling and closure type might substantially affect the flavour of the red wine used in this study. The ability to generalize from the results of this study to other red wines will also be established with further, extended investigations.

Industry development and support: extension and information transfer

Staff

Peter Godden, Adrian Coulter, Mark Gishen, Geoff Cowey, Matt Holdstock, Narelle D'Costa, Ella Robinson, Yoji Hayasaka and Gayle Baldock

Winemaking and other technical consultation

The Industry Development and Support team provides a winemaking consultancy service principally through the Manager, Peter Godden, a qualified and experienced winemaker, Adrian Coulter, a Graduate in the Diploma in Oenology from The University of Adelaide, and Mark Gishen, a qualified chemical engineer with a masters qualification in mechanical engineering science. Adrian entered the wine industry in 1980 and worked for a major South Australian winery, before obtaining his BSc in 1988 and commencing at the AWRI in 1989, and has worked eight vintages, the most recent being in 2001. Mark had gained six years wine industry experience before joining the AWRI in 1994. Of the other members of the team, Geoff Cowey (BSc Hons) had gained five years of wine industry experience before joining the AWRI in 2001, and is currently undertaking undergraduate studies in winemaking at Charles Sturt University, and undertook vintage experience with a winery in Tasmania in 2005. Matthew Holdstock (BSc) is also a Graduate of the Diploma in Oenology from The University of Adelaide, and has overseas winemaking experience.

Most queries received arise predominantly from Australian winemakers, and are technical in nature. However, many queries are also received from wine industry suppliers and Government bodies, as well as a relatively small number from the general public and secondary and tertiary students. The majority of queries are answered either by telephone, increasingly by e-mail, or by facsimile, and as a result of these enquiries, Industry Services staff supplies approximately five hundred technical papers or other pieces of relevant literature to callers each year, via the John Fornachon Memorial Library. Increasingly, team members are also able to direct callers to web-based information, both on the AWRI's own, and other web sites, and the support facilities provided by other AWRI research and library staff members are important in supplying relevant information to callers. Furthermore, the analytical capacity of the Industry Services Laboratory plays an important role in responding to many of these enquiries.

A summary of the enquiries received by Peter Godden, Adrian Coulter, Mark Gishen, Geoff Cowey, Matthew Holdstock and Ella Robinson, during over the last three years is presented in Table 3.

Table 3. Enquiries received by advisory staff during the past three years

	2002 /03	2003 /04	2004 /05
Wineries	1184	1220	1047
Government organisations	97	57	101
Other	368	431	326
Students	27	40	28
Total	**1676**	**1748**	**1502**

The current year figure shows a 14% decrease in the number of enquiries received, compared to the previous year. The total of 1,502 calls during the current reporting period is the lowest figure recorded since the 1998/1999 year (1,504). It is possible that the decrease in the number of enquiries received is a result of increased usage of the *Practical Solutions* section of the AWRI website, which might negate the need for many people to contact advisory staff directly. It is clear from consistent feedback received on AWRI Roadshows, that there is a high degree of awareness and use of this section of the website. Nevertheless, the number of calls received from wineries remains relatively high and indicates that a large number of personnel in the Australian wine industry regard the AWRI as an important or primary source of technical information.

The Investigative and Advisory Services are supported by Roadshow seminar and workshop tours, which are made on a rotating basis to 26 wine growing regions. During the year, workshops and a seminar were held in Queensland (Toowoomba), and workshops were staged in three regions in NSW (Griffith, Cowra and the Hunter Valley) (see Appendix 1). Cowra had not previously hosted an AWRI Roadshow. Roadshows are generally organised in conjunction with local vignerons' associations, whose assistance is acknowledged.

Regional winemakers' and growers' associations are asked to select the presentations to be made at each Roadshow seminar from a list of over 40 areas of current AWRI activity, in order that seminars are closely tailored to the interests and needs of the audience. In addition to the formal presentations, Roadshows are also considered an important vehicle for the delivery of informal advice, and it is considered that if this contact were formally recorded then it would account for a substantial increase in the number of enquiries recorded in Table 3. The most common areas of informal discussion on recent Roadshows continue to be *Dekkera/ Brettanomyces* and other microbiological stability issues, red wine phenolics and assays for colour and tannin quantification, salinity both in terms of soil and vineyard effects and effect on wine, closure issues, and the use of non-conventional yeasts.

The eighteenth Advanced Wine Assessment Course was held in September 2004, giving another thirty participants the opportunity to develop and test their sensory evaluation performance. This was the sixth course presented under a four-day format, which includes over 40 hours of activities over the four days, and 14 leading wine show judges, journalists and winemakers assisted in the presentation of the course. As in the past, results of the course were used in the selection of Associate Judges for the 2004 Adelaide Wine Show. Similar approaches from other wine shows continue to be encouraged.

The course was staged in September for the first time, so as to avoid a clash with the 12 AWITC. Staging the course in September rather than July proved beneficial for a number of reasons, such that a decision has been made to run future Adelaide courses in September. Most importantly, the availability of recent Melbourne wine show results aids the selection of relevant wines for the course, of which the primary aim remains the preparation of new potential wine shows judges.

From 2005 onwards, two Advanced Wine Assessment Courses will be staged each year, with two courses scheduled in September and October 2005, to be conducted in Adelaide.

Advanced Wine Assessment Courses are increasingly used as a forum from which data of relevance to various AWRI projects can be gathered, and an article based on such data was published in the August 2004 issue of *Technical Review* (Cowey and Godden 2004). The data are gathered without detracting from the value of the course for participants in any way. As with the 2003 course, an assessment was made of the number of wines that were considered by consensus of the participants and guest judges to exhibit *reduced* character, during the 2004 course. 18.2% of the wines used on the course were sealed with screw caps and 77.9% were sealed with cork. Three wines that were sealed with screw caps were considered by consensus to exhibit *reductive* character. Two were Rieslings, which were also considered to exhibit attenuated fermentation character and elevated volatile acidity. The other was a NZ Chardonnay that was so strongly *reduced* that the character was, apparently, a winemaking issue, and not related to the type of closure used. None of the 18 bottles of red wine sealed with screw cap were considered to exhibit reductive character. There were 17 wines sealed with cork that were considered by consensus to exhibit *reductive* character. It is again considered likely that the *reduced* character in all of these wines was related to winemaking problems, rather than the type of closure used. Therefore, a slightly higher percentage of wines sealed with cork were considered to exhibit *reduced* character, compared to wine under screw cap, although the difference was not statistically significant. Additionally, as with the 2003 AWAC, there appeared to be no relationship between the filling height at bottling (adjusted to 20°C) and the incidence or perceived intensity of *reductive* characters in wines sealed with screwcaps, noting that few of these wines exhibited any reductive character. The range of ullage space in the 112 bottles under screw cap that were used on the course, was 9 mm to 68 mm.

Approximately 30 bottles were considered by consensus of the participants and the guest judges to be oxidised. All but three of these bottles were sealed with corks, and the others with synthetic corks. Two of these bottles were red wine from the 1998 vintage, which is considered to be beyond the storage life recommended by the manufacturer of the closures used. Sixteen bottles (3.4%) were considered to exhibit TCA taint, all of which were sealed with cork.

The Group Manager made presentations on the subject of wine closures and post-bottling wine development at both the *1st International Screwcap Symposium* in New Zealand in November 2004, and *Enoforum* in Piacenza, Italy, in March 2005, whilst Ella Robinson (Chemist) also made a presentation at the *Science of Closures Seminar* in Seattle, USA, in June 2005, on the same subject (see Appendix 1). In addition to updating the results of the *AWRI trial of the technical performance of various types of wine bottle closure,* the presentations were expanded to review other AWRI trials that have elucidated factors that impact on the changes that occur in wine after it is bottled. It is considered that the most fundamental outcome of the closure trials and other research on post-bottling wine development that have been conducted at the AWRI, is the proposition that when bottling conditions are changed, an irreversible process of creating 'different wines' begins. It is clear that the differences induced can be profound, and can be of greater magnitude than those attributable to many vineyard or winemaking variables. Further understanding of this concept will give rise to enormous opportunities for optimising wine development after bottling. Thus, the role of the winemaker will continue after wine is bottled. The media contacts received by the Group Manager as a result of these conference presentations are listed in Appendix 5. Most notable of the resulting articles has been the cover story of the March 2005 issue of *Wine Spectator* (USA), and articles in the February 2005 issue of *La Vigne* (France), and the May 2005 issue of *Harpers magazine* (UK).

Industry Development and Support team members made a number of other seminar presentations during the reporting period, chiefly relating to the management of *Dekkera/ Brettranomyces* yeast during winemaking, (see Appendix 1). The team has made presentations on strategies to control *Dekkera/ Brettranomyces* yeast to a total audience of approximately 4,000 winemakers and other winery technical staff in the last five years, and encouraging data continue to be collected that indicate that the strategies advocated have been widely adopted by the Australian wine industry (see research teams' reports).

Many of these presentations have been made under the *Targeted training of wine industry personnel: compilation of a technical reference manual and delivery of complementary workshops* project, which commenced in 2000. The primary aim of this project is to utilise the vast amount of collective knowledge pertaining to grape and wine production that is held by the AWRI. Much of this information has been generated over the years by research and Industry Services' projects that have been supported by industry research levy funding. Although this research has produced many technical publications, there is also a great deal of information generated and recorded in a more informal manner by the staff concerned. In addition, a great deal of data pertaining to the composition of Australian wine is stored in various databases at the AWRI, some of which have been in existence for several decades. Collectively, this information is a resource of great potential value to the Australian wine industry. This project therefore seeks to make a record of this information, so that it can be delivered to the industry in a manner in which it is both readily useable, and relevant to those involved in day-to-day wine production. The development of these resources will be ongoing, and many areas of interest to winery technical personnel will be addressed in due course.

An important role of the project has been the development of the AWRI *Practical Solutions* website. New material is periodically added to the website, and the existing information is enhanced. During the current year, a major new section dealing with the establishment of winery laboratories has been added to the website. The website has also been enhanced with the addition of a number of new pictures to the Photo Gallery and the inclusion of a section that provides AWRI Technical Notes. Australian wine industry personnel can access the information at http://www.awri.com.au/practical_solutions/ or, alternatively, via the AWRI Home Page by selecting 'Practical Solutions', followed by 'Hazes and Deposits' and 'Microbiological Instabilities'. This section of the site is password protected (the password has previously been supplied to Australian wineries). Australian grapegrowers and winemakers who require the password, and who can confirm that they pay the Wine Grapes or Wine Research Levy, can obtain it from the AWRI's Librarian, Catherine Daniel (Catherine.Daniel@awri.com.au). However, other sections of the AWRI's website also contain a great deal of other technical information, which is readily accessible by interested parties.

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Industry development and support: technical problem solving and consulting

Staff

Peter Godden, Adrian Coulter, Mark Gishen, Geoff Cowey, Matt Holdstock, Narelle D'Costa, Ella Robinson, Yoji Hayasaka and Gayle Baldock

The Industry Development and Support team provides technical development and support services to the Australian wine industry, primarily in the form of an advisory service that disseminates a wide range of technical information, and a problem solving and analysis service, which collectively represent a significant proportion of the team's workload. The team coordinates an AWRI-wide project that is investigating the relationships between the potential spoilage yeast *Dekkera/Brettanomyces* and wine in Australia, and this project became the team's major research focus during the year. Additionally, the development of a web-based technical reference manual for the Australian wine industry has continued, which complements the team's problem solving and analysis service, and workshops that are presented in conjunction with AWRI Roadshow seminars in 26 winemaking regions around Australia.

The 12th Australian Wine Industry Technical Conference was held in Melbourne in July 2004 and the Industry Development and Support team took primary responsibility for coordinating the staging of 67 workshops at the conference, in conjunction with many industry participants and staff of the CRC for Viticulture. The team Manager also served on the conference's Planning and Program Committees. The team presented three workshops and one poster at the conference (see Appendix 1). In addition to participating in the three workshops organised by the Industry Development and Support team, the Oenologist also delivered a presentation at the workshop entitled *Wine microbiological spoilage: current and emerging issues,* convened by Dr Paul Grbin of the University of Adelaide (see Appendix 1).

Industry Development and Support team members are also regular contributors to the AWRI's *Technical Review,* periodically provide presentations for external seminars and conferences, and also provided 64 hours of lectures to Oenology students at the University of Adelaide (see Appendix 2).

The Industry Services Laboratory analysed in excess of 1,700 samples during the year (Table 4), using a wide range of routine and novel analytical techniques. An increased reliance on advanced analytical methods provided by the Waite Campus Mass Spectrometry Facility and the AWRI's commercial Analytical Service is acknowledged. The majority of samples analysed are wine, the analysis of which is supplemented by detailed sensory evaluation by a panel of experienced tasters. The remaining samples predominantly consist of wine additives, closures, or compounds that are suspected to have caused taints and or deposits in wine.

Industry Development and Support staff members increasingly regard their role as educational, seeking to disseminate information in a variety of ways in order to foster industry wide understanding of the causes of many common winemaking problems, in order to prevent their frequent recurrence. The continued enhancement and increased frequency of delivery of workshops on AWRI Roadshows, and the further development of the AWRI *Practical Solutions* website, are part of a coordinated strategy that seeks to provide wine producers with targeted information to enable them to avoid wine quality loss during processing and packaging.

The team also provides technical support to the AWRI's Analytical Service, with appropriate cross-charges in place, particularly in the maintenance and auditing of the quality management system, and the interpretation of analytical results. The Analytical Service also supplies chemical analysis on problem solving and research samples to the Industry Services team, on a contractual basis.

The AWRI's investigative and advisory services are provided according to strict Terms and Conditions, and client confidentiality is an important aspect of the provision of the services. This facilitates a frank exchange of information between the AWRI and its clients, which in turn maximises the knowledge gained from the provision of these services.

A summary of the number and type of investigations conducted by the Industry Development and Support team over the past three financial years is presented in Table 4. The number of investigations conducted remains approximately the same as the previous year, however, the total number of samples analysed as part of these investigations increased by 37%. The increase in the number of samples analysed is largely due to an increase in the number of investigations recorded as 'other investigative analyses', which often involves analysis of dozens of samples. The number of investigations related to hazes and deposits and microbiological instabilities has remained stubbornly high, despite the emphasis placed on addressing such issues in AWRI Roadshow workshops and the *Practical Solutions* website. It is apparent, though, that an increased awareness of these problems generated by Roadshows tends to lead to a spike in the number of samples received from particular regions immediately following the staging of workshops. Nine such workshops were staged during the current year.

Most of the investigations recorded in Table 4 result in a full written report being prepared for the client. These reports contain a large amount of technical information relating to the problem being investigated and are written in a way which seeks to explain the underlying causes of the problems encountered, and provide advice on how to prevent their re-occurrence. The reports are often accompanied by a number of technical references relating to the area of investigation.

Table 4. Summary of the number and type of problem solving investigations conducted, and numbers of samples analysed by Industry Services during the past three years

Investigations conducted and samples analysed	2002 /03	2003 /04	2004 /05
Identification of hazes and deposits	112	87	86
Microbiological investigations	95	93	107
Sensory assessments	89	60	42
Taint problems	72	46	31
Other investigative analyses	113	36	66
Closure-related investigations	20	19	5
Total number of investigations	501	341	337
Total number of samples analysed	2231	1262	1736

The types of investigations recorded in Table 4 as 'other investigative analyses' are extremely varied, and some particularly interesting and unusual cases have been investigated during the year.

- An investigation was conducted into a wine that had developed a taint, which the winemaker described as "petroleum/grease-like". It was reported that the taint had become apparent after the wine had been transferred to a tank using a mono pump with a new stator. Although it was reported that the pump had not 'run dry', the winemaker suspected that the new pump stator was responsible for the taint, as a parcel of the wine which had not been transferred using that pump did not exhibit the taint. Samples of the 'tainted' wine, the 'control' wine which was not tainted, and a portion of the pump stator (which had been cut in half) were submitted to the AWRI for analysis.

  The wine was considered to exhibit a 'diesel', 'hydrocarbon' or 'kero'-like taint during informal sensory assessment of the wine, whilst the 'control' wine did not exhibit such a taint. In addition, examination of the pump stator revealed some damage or imperfections in the stator material. Two 'imperfections' or 'voids' were observed in the cut surface, just below the stator surface, which would have been in contact with the wine during pumping. These two 'imperfections' or 'voids' appeared to be discoloured, suggesting that wine had entered them, and stained the stator material. Two small 'cuts' were also observed in the stator surface.

The 'tainted' wine, the 'control' wine, and some shavings taken from the pump stator were analysed by gas chromatography–mass spectrometry (GC-MS), utilising solid phase microextraction (SPME), by Yoji Hayasaka and Gayle Baldock. The dominant and indicative peaks in the pump stator shavings were tentatively identified as 2,2,4,6,6-pentamethyl-3-heptene, diisopropylbenzenes, isopropylmethyl styrene and butylated hydroxytoluene or BHT. The dominant peaks identified in the pump shavings were also detected in the 'tainted' wine sample, however, these peaks were not detected in the 'control' sample. The results therefore suggested that the wine had indeed become tainted during pumping by coming into contact with the inner pump stator material via the 'imperfections' or 'voids' observed in the pump stator.

- A winemaker who was concerned that the concentrations of copper in four wines had increased after they were treated to decrease the alcohol concentrations contacted the AWRI. The dealcoholisation process involved processing each wine through a reverse osmosis plant to generate a permeate stream which was then distilled to remove the alcohol. The dealcoholised permeate was then returned to the wine, thus reducing its alcohol content. It was found that the permeates had become contaminated with copper during the distillation process, which was conducted in a copper still. Whilst the concentration of copper in each of the wines was approximately 1 mg/L, which is below the permitted limit in Australian of 5 mg/L, the wines were destined for the American market, where the legal limit for copper is 0.5 mg/L. Fining with potassium ferrocyanide (PFC) successfully reduced the concentration of copper in each of the wines.

- The AWRI was contacted by a winemaker who had noticed a haze near the surface of a fortified red wine, a percentage of which was up to 40 years old. Apparently, the haze developed after the addition of a younger parcel of wine to the bulk fortified wine. Dissolved oxygen was implicated in the haze formation due to the fact that the haze only apparently developed at the wine's surface. Examination of the material responsible for the haze, after isolation by centrifuging, revealed mainly amorphous material. The fact that the haze was not microbiological in nature, combined with the information that the haze developed at the wine-air interface, suggested that the haze might be iron-related. The observation that a sample of the wine became hazier after aeration at the AWRI was also consistent with this hypothesis. Although iron is normally present as the ferrous ion in wine, oxidising conditions, which promote the formation of ferric (III) from ferrous (II), favour iron instability. In red wines, iron (III) reacts with the tannate ion to form a deposit of ferric tannate. Note that copper acts as a catalyst for oxidation in wine, and its presence therefore promotes the oxidation of ferrous (II) to ferric (III) ion. Heat also favours oxidation.

  The wine was found to contain concentrations of copper and iron very close to the concentrations suggested by Rankine (1989) as likely to lead to potential instabilities in table wines. However, metal instabilities may occur in high alcohol wines at lower concentrations of copper and iron than those that cause hazes in table wines (Rankine 1969). The main source of an elevated iron concentration in wine is considered to be contact with uncoated iron surfaces of processing equipment, such as may occur with grape bins, hoppers and presses where the paint has been chipped or has peeled off. In the case of fortified wine, concentration of metals may occur with time during storage due to evaporation.

  The haze was successfully removed from the wine with bentonite fining. It is difficult to determine why the haze formed after the addition of a younger parcel of wine. However, it is possible that addition of the younger wine changed the composition of the blend, such as lowering the pH and or the alcohol concentration, such that conditions were more conducive to haze formation, or increased the iron concentration. Iron haze is more likely at lower pH (Rankine 1989) and tannins are less soluble in lower alcohol concentration (Rankine 1969). However, data were not available for the younger wine to determine whether or not these factors might have influenced the formation of the haze.

- Four separate investigations conducted into hazes in white wines, which were determined to consist of copper-protein complexes, appear to have their origins in additions of copper sulfate made immediately before bottling. In one case the copper sulfate was added in order to correct a reduced, sulfidic off-odour, however, in the other three cases the copper sulfate was added as 'protection' against reduction/sulfide problems that might occur after bottling. In all cases the wines were packaged in bottles sealed with screw-cap closures and contained concentrations of copper greater than that suggested by Rankine (1989) as likely to lead to potential copper instability in white wine (0.5 mg/L). Note that other authors (Shields 1986, Amerine and Ough 1980) recommend a maximum of 0.2–0.4 mg/L of copper in order to avoid instability. In the three cases where the copper sulfate was added as a preventative measure, the winemakers indicated that prior to the addition of copper sulfate the wines had passed the standard heat stability test recommended by the AWRI (80°C for six hours). This indicates that copper instabilities can occur in wines that presumably contain very little protein.

  In order to avoid copper-protein instabilities after bottling, it is recommended to winemakers that they avoid adding copper sulfate to white wines immediately before bottling. If winemakers insist on adding copper sulfate to wines as 'protection' against reduced/sulfide problems that might occur, then it is recommended that sufficient time be allowed for the wines to 'self-stabilise' in bulk storage, so that any copper-protein haze that might develop can be corrected before bottling. It is also suggested that the copper concentration in a wine treated with copper sulfate be determined in these cases, as the concentration of copper in a white wine is a useful indicator of the likelihood of that wine developing subsequent copper instability. In addition, it is also emphasised to winemakers that if copper sulfate is added to a wine to remove a sulfide-type off odour, then the amount added should be the minimum necessary to remove the odour.

- Samples of potassium metabisulfite (PMS) contaminated with dark-coloured particles were submitted for analysis to determine the composition of the contaminant. The presence of the 'particles' was discovered when they remained on the filter-pads after filtration of a wine that had received an addition of the contaminated PMS. The AWRI was informed that aqueous solutions of this PMS (containing the 'particles') were observed to be yellow in colour. Solutions of pure PMS are colourless.

  Stereomicroscopic examination of the 'particles', after removal from the PMS, revealed irregular surfaces, mainly dark-brown/red to rust-coloured. Some of the 'particles' had smaller, yellow, crystal-like structures embedded within them. The 'particles' were insoluble in water (which remained clear), but slowly dissolved in 10% hydrochloric acid (HCl) solution, which turned yellow in colour. The PMS from which the 'particles' were removed was also soluble in water and 10% HCl, however, these solutions did not turn yellow, but remained colourless.

  Both the 'particles' and the PMS separated from the 'particles' were analysed for the presence of a range of elements using inductively coupled plasma atomic emission spectrometry (ICPAES). The assistance of the University of Adelaide ICPAES unit is acknowledged. The element present in the greatest abundance in the 'particles' was iron, which comprised approximately 50% of the 'particles' isolated from one of the PMS samples. Sulfur and potassium were the next most abundant elements in the 'particles' and may have originated from the PMS. A range of other elements were detected in the 'particles' that were not detected in the PMS samples, which included (in decreasing amounts) manganese, barium, calcium, chromium and strontium. The fact that the 'particles' consisted largely of iron, combined with the observation that the 'particles' were mainly dark-brown/red to rust-coloured, suggests that they may have contained an oxide, or oxides of iron (rust).

  It is possible that the smaller, yellow, crystal-like structures that were embedded in the 'particles', as observed during stereomicroscopic examination, may have been elemental sulfur, as the most common form of solid sulfur (orthorhombic sulfur) occurs as yellow crystals (Cotton and Wilkinson 1980). The sulfur may therefore have been responsible for the yellow colour observed in solutions of the PMS (containing the 'particles'), as reported to the AWRI.

  The PMS samples from which the 'particles' had been removed contained large proportions of sulfur and potassium, as would be expected for solid PMS. Note that the ratio of potassium to sulfur in these samples was approximately 1.3, which is consistent with the ratio observed (1.3) for these two elements in commercially available PMS (Windholz 1983).

  After the results were reported to the client, the AWRI was informed that the producer of the PMS had determined that the 'particles' were in fact rust from exposed steel beams situated above the PMS production and packaging area in the factory.

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The application of research and development to industry problems and opportunities

Trial of the technical performance of various types of wine bottle closure

The five-year post-bottling testing for the trial of the technical performance of various types of wine bottle closure was performed in August 2004, 63 months after the trial was bottled.

As with the testing conducted in 2003, only five of the original 14 closures were tested: the ROTE (roll-on tamper-evident) or screwcap closure, the reference 2 and reference 3 natural corks, and the Altec and One plus One technical corks. Mean data for SO_2 concentration and OD_{420} measurements recorded at 63 months post-bottling, for bottles that had been stored in an inverted position, are presented in Table 5. The ROTE and Altec closures continue to retain significantly higher concentrations of SO_2 than the reference 2 and One plus One closures, which in turn retain significantly higher concentrations of SO_2 than the reference 3 corks. OD_{420} values continue to strongly negatively correlate with SO_2 concentrations.

Table 5. Mean SO_2 concentration and optical density at 420 nanometers (OD_{420}) following 63 months of storage in an inverted position

		63 months inverted storage (n=12)
Altec	Free Total OD_{420} (au)[b]	12 (1)[a] 75 (2) 0.170 (0.005)
One plus One	Free Total OD_{420} (au)[b]	8 (2) 67 (3) 0.200 (0.009)
Reference 2, 44 mm cork	Free Total OD_{420} (au)[b]	7 (3) 63 (12) 0.204 (0.018)
Reference 3, 38 mm cork	Free Total OD_{420} (au)[b]	3 (2) 51 (9) 0.228 (0.012)
ROTE	Free Total OD_{420} (au)[b]	13 (2) 79 (5) 0.172 (0.004)

[a]figures in parentheses are standard deviations,

[b]au = absorbance units (cuvette measurements)

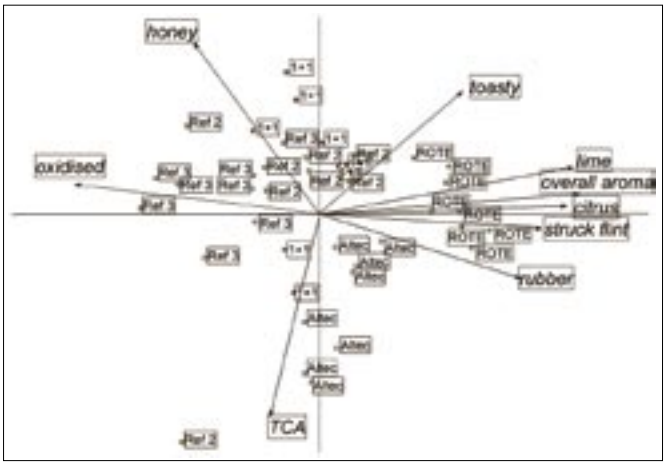

Figure 4. Biplot of principle components 1 and 2 for mean scores of sensory descriptive analysis data, for individual bottles sealed with each closure assessed after 63 months' storage in an inverted position (n = 8)

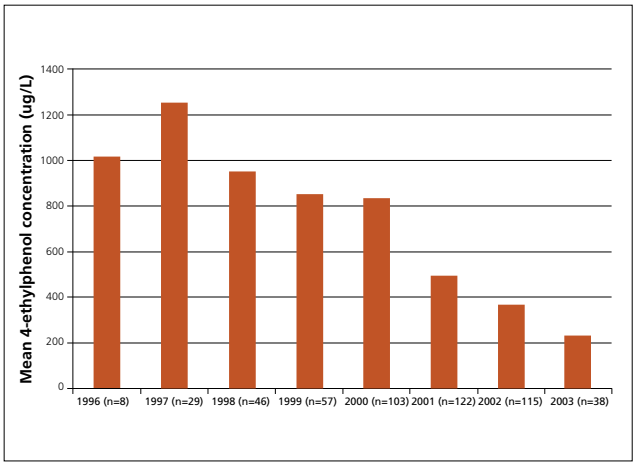

Figure 5. Mean 4-ethylphenol concentrations in Cabernet-Sauvignon-based wines from five Australian wine regions (Barossa Valley, Coonawarra, Margaret River, Hunter Valley and Yarra Valley) for the vintages 1996 – 2003

A Principal Component Analysis (PCA)-plot derived from sensory analysis conducted on eight bottles sealed with each of the five closures 63-months post-bottling, is presented in Figure 4.

During sensory evaluation, the ROTE closure continued to receive the highest ratings of the five closures tested, for the attributes *overall fruit aroma, citrus, lime, struck flint* and *rubber,* and conversely, the lowest ratings for *oxidised* and *honey.* Ratings for the attribute *rubber* for six of the eight bottles sealed with the Altec closure were of a similar magnitude to those recorded for the ROTE closure. However, while the rating for the attribute *struck flint* received by the Altec closure was the second highest of the five closures, the magnitude of the rating was significantly lower than that received by the ROTE closure. This suggests that the sensory panel is using the terms *struck flint* and *rubber* independently.

The reference 3 cork closure was rated highest for the attribute *oxidised,* followed by the reference 2 cork, and the One plus One closure. Thus, principle component 1, *overall fruit aroma, lime* and *citrus* versus *oxidised,* continues to correlate strongly with SO_2 concentration and wine colour measured by OD_{420}. Principle component 2 continues to relate to the presence of TCA. All bottles sealed with the Altec closures, two of the bottles sealed with the One plus One closure, and one bottle sealed with each of the reference 2 and reference 3 cork closures, were considered to exhibit TCA taint.

Investigations into the relationship between *Dekkera/Brettanomyces* yeast and red wines in Australia

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In red wine, the only microorganism proven to produce significant amounts of 4-ethylphenol and 4-ethylguaiacol is *Dekkera/Brettanomyces bruxellensis,* hence our association of these compounds (and their aromas) with the winemaking problem called 'Brett'. The AWRI *Dekkera/Brettanomyces* project involves staff from several disciplines, with investigations into both the chemical and biological nature of 'Brett'. The long term goal of these investigations is to place scientific evidence behind a comprehensive control strategy, for the benefit of the Australian wine industry—enabling winemakers to control the level of 'Brett' in their wine to a degree with which they are comfortable.

A survey of commercially bottled Cabernet Sauvignon and Cabernet Sauvignon/ Merlot blended wines from five Australian wine producing regions (Coonawarra, Hunter Valley, Barossa Valley, Margaret River and Yarra Valley) has continued. Two hundred and forty three wines from the vintages 1996 to 2000, and two hundred and seventy five wines from the vintages 2001 to 2003 have been analysed. Data from the analysis of samples added to the survey during the current year provide further evidence that a substantial reduction in mean 4-ethylphenol concentration occurred in the 2001 to 2003 vintages, compared with the previous five vintages (Figure 5).

There were no significant differences in the median or mean concentrations of 4-ethylphenol for the vintages 1996 to 2000. However, the mean concentration of 4-ethylphenol in wines from the 2001 to 2003 vintages, compared to the mean of the pre-2001 wines, fell by 63% (data not shown). It should be noted that the sample of wines currently analysed from the 2003 vintage is probably skewed towards wines that have received shorter than average barrel maturation, and that the mean 4-ethylphenol for this vintage may increase as a more representative sample becomes available. Furthermore, the age of the wines at the time of analysis has generally decreased as the survey has progressed, although it is considered similar for wines from the 2000 to 2003 vintages (see note below Figure 5). Valid comparisons are therefore dependent on there not having been development of 4-ethylphenol in bottle prior to analysis.

Note: The average age of wines at the time of analysis has fallen as the survey has progressed. Analysis commenced in January 2002, and whilst wines from the 1996 to 1999 vintages were predominantly analysed during 2002, additional samples from these vintages are continually added to the survey as they become available. Analysis of wines from the 2000 vintage commenced when they became commercially available in early 2002, and likewise, analysis of 2001 wines commenced in early 2003, and 2002 wines in early 2004. Therefore, the average age of wines from the 2000, 2001, 2002 and 2003 vintages at the time of analysis is considered to be similar. However, it has also been noted that the date at which certain wines have become commercially available is up to five months later for the 2003 vintage wines, compared to the 2000 vintage wines. Furthermore, it should be noted that the sample of wines from the 2003 vintage analysed to date, might be skewed towards wines that have received shorter than average barrel maturation.

The factors that contribute to one red wine developing a higher concentration of 4-ethylphenol than another, are poorly understood. One possible mechanism is the presence of different *Dekkera/Brettanomyces* yeast species, and/or strains in wines, with differential capacity to produce 4-ethylphenol. More than 330 isolates, confirmed to be *Dekkera bruxellensis* by Polymerase Chain Reaction Restriction Fragment Length Polymorphism (PCR-RFLP) analysis, have now been obtained from either barrel samples or samples of commercially bottled Australian red wines by the Industry Development and Support team. No other *Dekkera/Brettanomyces* species have been isolated, making it of critical importance to differentiate the yeast at the intra-specific level.

Amplified Fragment Length Polymorphism (AFLP) analysis of genetic diversity amongst *Dekkera bruxellensis* isolates has been reported previously in the 2003 and 2004 Annual Reports. In the current year, AFLP was conducted on a further 141 isolates, bringing the total number analysed to 261. Importantly, several isolates were from regions not previously represented in the study (see Figure 6), including the Hunter Valley, Murray Darling, Clare and Frankland River regions. All new isolates belonged to one of the seven strain groupings previously discerned, with the vast majority classified as strain 'A'. Of the 261 *Dekkera/Brettanomyces bruxellensis* isolates analysed to date, 84% (see Figure 7) were found to be strain 'A', with representatives found across the country in 29 winemaking regions. The results of this extensive study into *Dekkera/Brettanomyces* genetic diversity and strain distribution are being written up for publication in the near future, and will be used to ensure that ongoing studies will be of greatest relevance to the Australian wine industry, by focusing on the most commonly encountered strains.

Before such a narrow focus can be taken, representative isolates from each of the seven AFLP strains must be physiologically characterised, with emphasis on their differential capacity to grow in wine, and to produce volatile phenols. A major focus has been the continuing validation of a high-throughput multi-well microplate system, as this format will enable a significantly more powerful determination of yeast phenotype than would be possible by standard laboratory tests. Several technical issues have been identified in the current year, including 'scalping' effects. The types of plastic used in the microplates themselves, and the membrane used to seal them, were found to be partly responsible for loss of both volatile phenols and key yeast fermentation products. Predominantly though, excessive volatilisation due to the small volume to surface-area ratio appears to be the cause. Multi-well plates were originally designed for mammalian tissue culture and enzyme-linked immunosorbance assays, where volatile compounds are not important. 'Scalping' is not an issue that has been considered in the literature previously, even where microplates have been utilised for physiological characterisation of yeast (Warringer and Blomberg 2003), hence there are no reliable precedents upon which to build. Ongoing work is aimed at elucidating the parameters that can be reproducibly examined in the microplate system, so that the project can proceed.

Reproducible physiological characterisation will also require consideration of exposure of cultures to oxygen. Oxygen is well known as a yeast stimulant, particularly in terms of *Dekkera* spp. growth and fermentation rates (Wijsman et al. 1984), however to date there is little information regarding the influence of oxygen on 4-ethylphenol production. During the current year, experiments were conducted with a strain 'A' representative in chemically defined medium under three levels of aeration — strict anaerobisis (in anaerobic hood), semi-anaerobisis (in shake-flasks with fermentation locks), and aerobisis (shake-flasks with cotton wool bungs). Significant differences between the treatments were seen in the production of 4-ethylphenol and other key metabolites.

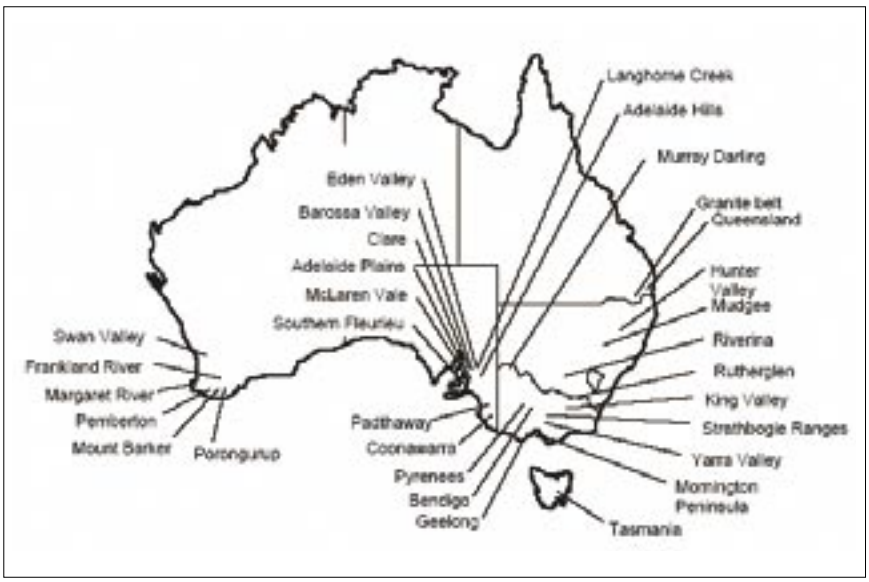

Figure 6. Australian winemaking regions from which Dekkera/Brettanomyces bruxellensis *yeast have been isolated*

Regular interactions of AWRI staff with the Australian wine industry have identified several other aspects of *Dekkera/Brettanomyces* work that are considered high priority by industry. These include investigating the source of *Dekkera/Brettanomyces* infections in wineries, reliable detection of the yeast before it establishes large populations in wine, and prediction of the potential for a wine to go 'Bretty'. Preliminary work was done in the current year to address these areas, which will form the basis for further work in the coming year.

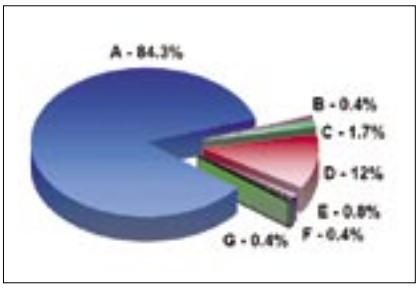

Figure 7. Relative abundance of Dekkera/Brettanomyces bruxellensis *strains isolated in wine samples taken from 31 different winemaking regions in Australia, as determined by amplified fragment length polymorphism (AFLP) analysis*

With regards to the source of *Dekkera/Brettanomyces* infection in wineries, anecdotal evidence suggests a path into the winery with grapes. While there is no scientific evidence that *Dekkera/Brettanomyces* yeast exist on grapes, some winemakers are convinced that certain vineyards yield wines that are more 'Bretty' than others. A small-scale winemaking trial was established in parallel with commercial winemaking to investigate whether grapes from three different vineyards yielded wines with different degrees of 4-ethylphenol and 4-ethylguaiacol. To date, neither the commercial nor the small-scale wines have detectable *Dekkera/Brettanomyces* yeast populations, nor do they have detectable concentrations of 4-ethylphenol or 4-ethylguaiacol.

Detection and quantitation of viable *Dekkera/Brettanomyces bruxellensis* populations in wine by traditional plating methods is both difficult and time-consuming. During the current year, work commenced on assessment and validation of a Quantitative Polymerase Chain Reaction (QPCR) method for rapid enumeration of *Dekkera bruxellensis* populations in wine, which will utilise the BioRad iCycler system recently purchased by the AWRI. Two recent publications exist in this area (Delaherche et al. 2004; Phister and Mills 2003) indicating the potential for this methodology, which enables quantitative detection of *Dekkera/Brettanomyces bruxellensis* populations within a single day. All seven Australian *Dekkera/Brettanomyces bruxellensis* strains identified thus far are detectable by this method, although further validation is required to ensure detection of viable cells only.

There exist in the literature a number of HPLC analytical methods for wine phenolic compounds such as coumaric and ferulic acids — the precursors for 4-ethylphenol and 4-ethylguaiacol. While little information exists concerning typical concentrations of these compounds, coumaric acid concentrations have been reported to range from not detectable up to 16 mg/L in wine (Gambelli and Santaroni 2004). If 16 mg/L coumaric acid was completely converted to 4-ethylphenol by *Dekkera bruxellensis,* such a wine would contain approximately 10,000 µg/L 4-ethylphenol. Preliminary work conducted at AWRI in 2002 indicated that in wines with significant levels of 4-ethylphenol there was up to 10 mg/L of coumaric acid remaining, suggesting that the precursor concentration was not limiting.

No published studies have linked concentrations of precursor compounds to the level of volatile phenols in wine, most likely because no method has enabled simultaneous quantitation of all precursor compounds and their key esters. Given the potential for varietal and regional differences in concentrations of these compounds, as previously reported there has been ongoing development of a method for 'Brett' precursor analysis to facilitate investigations into the relationship between their concentrations and the level of eventual 'Brett'-related volatiles in wine.

A preliminary trial of published methods was conducted, with a formic acid:acetonitrile reverse-phased step gradient system (Chamkha et al. 2003) yielding best results in terms of baseline stability and peak resolution. Working with Yoji Hayasaka and Gayle Baldock of the Waite Campus Mass Spectrometry Facility, this method was transferred to the ThermoFinnigan LCQ-Deca XP Plus Liquid Chromatography Mass spectrometer (LC-MS) to enable peak identification and further method refinement. With modifications to gradient parameters and the solvent system, resolution and peak shape of key esters were enhanced along with baseline stability. LC-MSMS analysis was conducted on wine and grape homogenate samples, along with commercial standards for some compounds, while anthocyanin coumarates were verified using extracts previously purified by Multi-layer Counter Current Chromatography, by AWRI staff in the Grape Composition and Wine Flavour project.

The project to develop a method for simultaneous quantitation of the major precursor compounds and their key esters in a single HPLC run has been successful, and the assistance of several AWRI staff over a period of two years, is acknowledged. The HPLC method that has been developed can detect coumaric, ferulic and caffeic (precursor for 4-ethylcatechol) acids along with their tartrate esters, glutathionyl-tartrate esters, and the coumaric acid esters of anthocyanins, in a run that lasts approximately 50 minutes. In the next year, stored wine samples will be analysed to determine typical precursor levels in Australian wine, including those from the current winemaking trial and the multi-region Cabernet Sauvignon 4-ethylphenol survey.

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Industry development and support: wine technology and processes (incorporating Rapid instrumental techniques)

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This project is part of the CRC for Viticulture.

Research into rapid instrumental methods at the AWRI has been investigating the application of promising rapid analytical techniques such as visible (Vis), near infrared (NIR) and mid-infrared (MIR) spectroscopy. The project has had a primary focus on furthering the development of NIR methods for the rapid analysis of red grapes including total anthocyanins, total soluble solids (TSS, °Brix) and pH. This analytical approach has been shown from earlier work to be capable of providing very fast, low cost analyses of a range of parameters important to commercial wine production. Spectroscopic techniques offer the potential to simplify and reduce analytical times for a range of grape and wine analytes. It is this aspect, together with the ability to simultaneously measure several analytes, which was the impetus for developing NIR methods. This is because the measurement of red grape colour (expressed as total anthocyanins) has shown great promise as an indicator of red wine quality, as it has been previously demonstrated that for a set of wines made under carefully controlled conditions with grapes from a specific region, red grape colour was correlated with both wine quality score and wine flavour intensity. However, since the laboratory techniques for the determination of red grape colour are time consuming and laborious, NIR spectroscopy offers potential for rapid analysis.

Table 6. Standard error in cross validation for NIR determination of the concentration of total anthocyanins and total soluble solids in red grape homogenates using various instrument types and sample presentation modes

		Standard error in cross validation	
Instrument type	**Sample presentation**	**Total anthocyanins (mg g^{-1})**	**Total soluble solids (%)**
Diode array	Mechanical harvested scanned on turntable	0.06	1.26
Diode array	Whole grapes scanned in jar	0.14	-
Monochromator	Whole grapes scanned in cuvette	0.18	1.70

Transfer of the technology to the industry through direct commercialisation activities, is being carried out under the responsibility of the Cooperative Research Centre for Viticulture's dedicated commercialisation company, CRCV Technologies Ltd. An agreement has been reached between an Australian-based spectroscopic instrument manufacturer and the CRCV made possible the development of a prototype rapid and cheap instrument for the industry to measure grape composition. In collaboration with wine industry partners, the prototype instrument has been evaluated during the 2005 vintage.

The consolidation of NIR calibrations developed for the analysis of grape berry colour, total soluble solids and pH has continued with the ongoing cooperation of industry partners so that more than 3500 berry samples from the 1999, 2000, 2001, 2002, 2003, 2004 and 2005 seasons, and from a wide range of growing regions and red varieties (but predominantly Shiraz and Cabernet Sauvignon), have been analysed by the conventional laboratory method and scanned with a research grade NIR instrument located at the AWRI. The project has continued to investigate the effect of sample presentation in NIR analysis, comparing homogenised with whole red grapes. During the last two vintages (2004 and 2005) testing of fast diode array instruments was carried out to determine the possibility of simplifying the sample presentation for NIR prediction of colour, TSS and pH that might dramatically increase sample throughput. Furthermore, this mode of presentation might even offer the potential of scanning whole, intact, single berries. Studies were performed using several compact, fast, diode-array spectrometers including the Zeiss *CORONA,* and included investigation of the feasibility of scanning samples directly in plastic jars that are commonly used when collecting grape samples. Preliminary investigations conducted in collaboration with a major winery for whole grape berry presentation were promising, indicating that NIR may have potential for use in the streaming of fruit on receival at the weighbridge or for in-field analysis. Calibration accuracy for various sample presentation methods and different instrument types for the measurement of red grape composition are shown in Table 6.

For many Australian wineries, storage of grape samples before analysis is often necessary because of the high throughput requirements (e.g. sometimes greater than 500 samples per day) and often freezing is required. We have previously reported the effect of storage (i.e. fresh or frozen) and type of homogeniser used on the reference laboratory determinations of red grape composition (AWRI publication #814), and now extended this with studies evaluating the effect on the Vis-NIR spectra and on calibrations for total anthocyanins, total soluble solids and pH. Full details have been submitted for publication in a scientific journal, and a brief summary of the main findings is presented here. It was observed that the type of homogeniser and overnight freezing of red grapes had a slight effect on the Vis-NIR spectra of the homogenates; however these did not affect the performance of the resulting calibrations for total anthocyanins, TSS and pH (Table 7). However, longer frozen storage period (greater than one month) did have an effect on the predictive ability of calibrations. These results suggest that it might be possible to use Vis-NIR calibrations developed on fresh or short-term frozen samples alone to measure the concentration of total anthocyanins, TSS and pH in either fresh or short-term frozen samples after appropriate slope and bias correction. In collaboration with a PhD student from James Cook University, the same data are being further investigated using alternative multivariate analysis techniques to evaluate the effect of freezing and frozen storage on the NIR spectra and a paper has been presented at an international conference on chemometrics.

The project team continues to collaborate with several research teams in investigating further applications of spectroscopy (e.g. NIR, MIR, UV and Vis). These include the discrimination and identification of yeast strains (AWRI Molecular Biology), the detection of moulds in grapes (University of Adelaide), the potential to monitor compositional changes during wine fermentation (AWRI Tannin and Microbiology) and oxidation in white wines (AWRI Oxygen and Wine).

Recently, the project team demonstrated the use of Vis and NIR spectroscopy to predict sensory panel attribute scores in commercial samples of two white wine varieties (unwooded Chardonnay and Riesling), through collaboration in a PhD project on identification of white wine flavour compounds conducted by Heather Smyth. This finding was published in an international peer reviewed journal during the reporting year (AWRI publication #828). A summary of the results for the calibration the prediction of sensory attributes in white wine is presented in Table 8.

A set of grape extracts and wines (n = 245) from the 2002-2004 Clare Valley trial were analysed by Fourier Transform MIR (FT-MIR) using attenuated total reflectance (ATR) for sample presentation to assess the possibility of calibrating for the determination of a range of properties including tannin, anthocyanin and other phenolic components, as well as identify the type of tannin (seed or skin).

Table 7. Statistics for the performance of NIR prediction of the concentration of total anthocyanins, TSS and pH in red grape homogenates using various combinations of validation and calibration samples sets

	n	SEP	R	RPD
Fresh predicted with overnight frozen	143			
Total anthocyanins mg g^{-1}		0.14	0.95	3.1
Total soluble solids		0.68	0.97	4.3
pH		0.05	0.90	2.8
Fresh predicted with 1 month frozen	143			
Total anthocyanins mg g^{-1}		0.17	0.91	2.5
Total soluble solids		1.60	0.85	2.0
pH		0.10	0.87	1.4
Overnight frozen predicted with fresh	176			
Total anthocyanins mg g^{-1}		0.11	0.93	3.6
Total soluble solids		0.69	0.97	4.2
pH		0.05	0.89	2.5

Notes: n: the number of samples in the validation set; SEP: standard error of prediction, R: correlation coefficient, RPD = SD/SEP where SD is the standard deviation of the sample set.

Preliminary results of PLS calibrations indicated a very good correlation between the spectra and reference data, however, the predictive ability of the calibration models on unknown samples was very poor, possibly due to severe overfitting and instability of the PLS regression models. Prediction of tannin concentration using the dried film ATR method was much more successful, consistent with the stronger tannin spectral signal and lower matrix interference in the dried films. Not only were the predictions improved but the PLS coefficients showed features consistent with the expected tannin spectral signatures.

The use of the FOSS WineScan for classification of wine varieties has shown a good separation of sweet from dry and dry red from dry white wine styles using data from the Analytical database, but has not been successful within the commercial dry white and dry red wines groups. Apart from the application of WineScan spectra for research purposes, progress has continued into the integration of the WineScan into the AWRI Analytical Services unit. Validation data generated by the AWRI Analytical services unit has been sent to FOSS (Denmark) for detailed chemometric analysis but the final results have not yet been received. As an interim step, analysis of this validation set was therefore carried out and completed in-house at the AWRI, pending the results by FOSS. Work is being planned to extend the range of the usual wine properties to be measured by the WineScan e.g. alcohol, pH, sugar, TA and VA, to other, less common properties, such as those of interest to sensory and wine quality applications research. NATA accreditation has been obtained for the basic wine analysis parameters.

Investigations into potential applications of an electronic nose (MS-based) instrument for rapid grape and wine analysis are continuing. Preliminary studies with both red and white wines have shown promise for the MS-ENose to successfully classify the samples by varietal origin using multivariate methods. Studies will be extended to investigate a range of other applications including the detection of taints, contamination, and wine development monitoring, as well as confirmation of varietal classification.

Table 8. Partial least squares (PLS1) calibration statistics for sensory properties in the combined set of white wine samples

Sensory attribute and wavelength range* (nm)	R_{cal}	% of variation explained by the model	SEC	SECV	PLS factors
Estery					
1100 - 2500 nm	0.84	71	0.43	0.74	8
Lemon (citrus)					
1100 - 2500 nm	0.80	64	0.38	0.51	7
Passion-fruit					
1100 - 2500 nm	0.52	27	0.92	0.96	1
Honey					
400 - 2500 nm	0.86	74	0.46	0.62	4
Sweetness					
1100 - 2500 nm	0.74	55	0.32	0.45	7
Overall flavour					
400 - 2500 nm	0.55	30	0.33	0.41	1

*Notes: SEC: standard error of calibration, SECV: standard error in cross validation, R_{cal}: correlation coefficient in calibration, * wavelength region between 1800 - 2000 nm was deleted.*

In another study in collaboration with Industry Development and Support, the Tannin Group and Wynn's Winery as an offshoot of a large tasting held by Wynns, a set of samples representing 50 vintages of bottled Wynns Coonawarra Cabernet (1954 to 2004) were scanned over the Vis-NIR range. Despite the fact that these were separate wines, rather than following a particular wine over 50 years and with the added complication of possible bottle variation, a distinct progressive pattern of change could be observed with PCA profiles, using the Vis-NIR spectra (Figure 8). Some older wines that anecdotally were of higher quality early in their life appeared further up the profile than expected and *vice-versa* for some younger wines. Thus it appeared that a spectral fingerprint of the original wine quality remained for decades. This method of analysis illustrates the power of spectral information in assessing wine quality and may be able to highlight, for example, abnormal maturation due to bottle variation or poor sample storage.

The team also maintains a strong commitment to the training and teaching of the principles and use of multivariate analysis techniques (chemometrics) to the Australian wine industry, and have developed materials for a workshop for winemakers, viticulturists and laboratory staff that was trialled at a large winery in South Australia.

In November 2004 the 'MIR spectroscopy users group' was launched at Beringer Blass winery bringing together the AWRI NIR team, and other researchers and practitioners involved in the development and application of IR spectroscopy in the research and industrial communities.

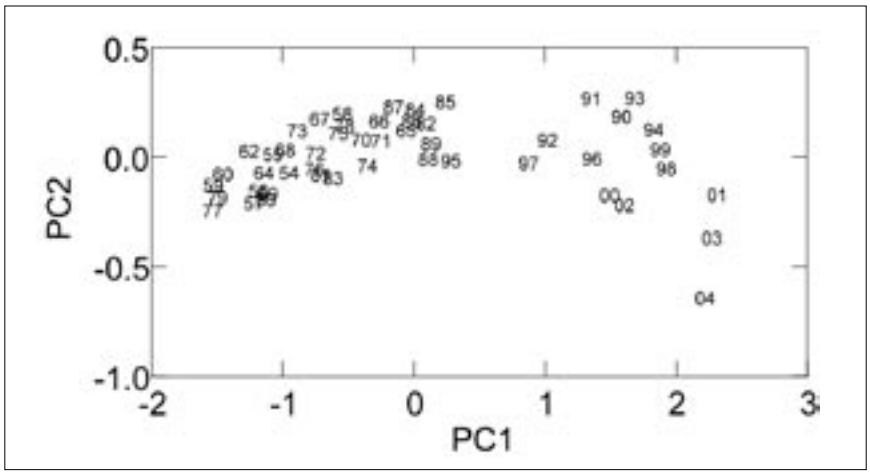


Figure 8. Spectral monitoring of wine maturation: principal component analysis of Vis-NIR spectra collected from 50 vintages of Wynns Coonawarra Cabernet. The first two principal components shown here explain 99% of the variation between samples. The wines show a sequential maturation profile but some wines with exceptional storage qualities appear out of sequence

Phil Ruthven
(IBIS World)

Technical, human and environmental health and management issues impacting on the Australian wine industry — research, repository, interpretation and communication of information

Staff

Creina Stockley, Professor Peter Høj (3/11/97–27/8/04) and Professor Sakkie Pretorius (from 30/8/04)

Ms Creina Stockley, a clinical pharmacologist, has assumed the position of Health and Regulatory Information Manager since 1991. One of the activities of the AWRI has been to provide health, regulatory and technical advice and assistance to the Australian wine industry, through the Managing Director, the Health and Regulatory Information Manager and the Industry Development and Support team; from 1 January 2005, the Health and Regulatory Information Manager has been included as a member of this team. From 1 July 2003, environmental information was added to the position description. From 1 July 2003 until 30 June 2004, 262 independent information requests were received by the Health and Regulatory Information Manager from industry (143), the general public (106) and government (11); of these 92 were health and nutrition related and 170 were science and technical related.

Industry committee membership

During the year, support to the industry has been derived from the Managing Director's membership on the AWBC/WFA Wine Industry Technical Advisory Committee, the Management Committee for Viticultural Publishing (ASVO), the Royal Adelaide Horticultural Society's Wine Show Committee, and the South Australian Wine Industry Council, as well as the Council of the Institut des Sciences de la Vigne et du Vin de Bordeaux. One of the important aspects of the AWRI's support of the Australian wine industry is its pivotal role in facilitating the triennial Australian Wine Industry Technical Conference (AWITC), in conjunction with the Australian Society of Viticulture and Oenology. Professor Peter Høj was the Chair of the 12th AWITC and Professor Sakkie Pretorius is the Chair of the 13th AWITC.

During the year, the Health and Regulatory Information Manager was a member of the following industry committees: AWBC/WFA Wine Industry Technical Advisory Committee (as Technical Liaison); the AWBC Legislation Review Committee; the Wine Industry National Environment Committee; the CRCV 'Good Environmental Management' Project Reference Group; and was the DAFF nominated Australian delegate for Organisation International de la Vigne et du Vin (OIV) Nutrition and Health Subcommission. She is also a member of the National Drug and Alcohol Research Centre's Young People and Alcohol Project Advisory Group on behalf of WFA.

Technical and regulatory issues

The technical and regulatory support to the Australian wine industry is ongoing as issues are regularly raised by industry or government, both in Australia and internationally, and often span several years. During 2004/2005, technical and regulatory information and/or issues that have been reviewed, and material prepared includes: dossiers on the 18 additives and processing aids used in Australian winemaking, which are not approved for use in Japan and a dossier on Japanese maximum residue limits (MRLs) that are inconsistent with Australian MRLs; an application to amend Standard 4.5.1 *Wine production requirements (Australia only)* of the Australian New Zealand Food Standards Code; comments on the *Opinion of the Scientific Panel on Dietetic Products, Nutrition and Allergies on a request from the Commission related to a notification from the Winemakers' Federation of Australia on milk products, egg products and fish products used in the manufacture of wine pursuant to Article 6 paragraph 11 of Directive 2000/13/EC (Request EFSA-Q-2004-084) (adopted on 19 October 2004);* comments on *the Joint FAO/WHO Food Standards Programme of the Codex Committee on Food Additives and Contaminants for the Thirty-seventh Session The Hague, the Netherlands, 25 – 29 April 2005 re food additives provision of the Codex General standard for Food Additives–GSFA — Draft and proposed draft food additives provisions requiring information on their use;* and a submission to the US Alcohol and Tobacco Tax and Trade Bureau re *Proposed changes to the labelling and advertising of wines, distilled spirits and malt beverages* at the behest, and on behalf, of WITAC. Reports were also prepared on the *Analysis of naphthalene in an Australian wine* for an Australian winery and on the *Analysis of Australian wine for 2,4-D* for the AWBC, as well as a fact sheet to accompany the latter. An oral presentation entitled *Evolution of wine regulations in Australia* was also prepared by the Health and Regulatory Information Manager and presented on her behalf by AWRI Councillor, Mr Peter Hayes, for the *Vinelink International 2005 Annual General Meeting* in Paris, France (see Appendix 1).

The Health and Regulatory Information Manager also coordinates Course 3005WT *Grape industry practice, policy and communication* for the School of Agriculture and Wine at The University of Adelaide. In its eleventh year, 43 students enrolled in the Course, which exposes students to organisational, commercial, environmental, political, societal and technical issues relating to the wine industry's operating environment (See Appendix 2).

Health and nutrition issues

As part of her responsibilities, a database of research on the beneficial and detrimental health effects of alcohol and in particular, wine, has been established on the internal database of the John Fornachon Memorial Library. This is facilitated by the subscription to relevant medical and scientific journals, and by the formal and informal exchange of information between complementary organisations, both national and international. The journals have been regularly scanned, the database of research on the health effects of wine has been added to and articles have been prepared for inclusion in the AWRI's publication, *Technical Review,* and for other Australian wine industry and international alcohol industry newsletters. Articles and other material have also been prepared for the electronic and print media. For example, three articles have been prepared for the bimonthly international publication, *AIM — Alcohol in moderation,* and two articles for the monthly *Australian and New Zealand Grapegrower and Winemaker,* in addition to one article for their annual technical issue. The Health and Regulatory Information Manager has co-authored with Professor Peter Høj a paper entitled *'Better wine for better health — fact or fiction?',* which was an oral presentation at the *Australian Academy of Technological Sciences and Engineering*; it has since been accepted for publication in the 50th AWRI anniversary issue of the *Australian Journal of Grape and Wine.* Two oral presentations were also made at the *Organisation International de la Vigne et du Vin (OIV) 2004 Congress* and *General Assembly* in Vienna, Austria, a keynote oral presentation was made at the Pharmacy Australia Congress 2004 in Adelaide, and two oral presentations were also made at The International Medical Advisory Group of the Brewers (see Appendix 1).

Nicolas Vivas
(France)

A workshop entitled *Medically, is wine just another alcoholic beverage? –results from the GWRDC-funded wine and health research projects* was also prepared and presented by the Health and Regulatory Information Manager at the 12th AWITC. This workshop presented the results from the GWRDC-funded wine and health research projects that have been undertaken since 1996, and gave an understanding to participants of the current status of wine and health research in Australia and internationally. Most of the research undertaken to date has focused on the role of wine in cardiovascular health, and also when consumed as part of a diabetic diet or in weight loss. Another aspect of research undertaken is the role of wine in minimising or preventing DNA damage; DNA damage leads to cancer and other diseases of ageing (see Appendix 1).

Submissions have also been prepared for the Drugs and Crime Prevention Committee Inquiry into Strategies to Reduce Harmful Alcohol Consumption (Victorian State government) and for the Comments on the Consultation Paper for the National Alcohol Strategy 2005–2009 (Federal government), which have espoused that balance is required in any recommendations and strategies concerning the benefits and harms of alcohol consumption.

Environmental issues

Complementary to the AWRI's databases on health effects of alcohol, a database on environmental issues impacting on the wine industry was instigated by the Health and Regulatory Information Manager at the behest of the Wine Industry National Environment Committee (WINEC). The database is a keyword specific alert service and is accessible to the general public without a user name and password, with linkages to industry associations and environmental agencies and authorities. Since its launch in May 2004, the database has received 1835 unique research requests, highlighting the relevance of the service.

Project coordination

Through Creina Stockley, the AWRI has played a coordinating and a participating role in a GWRDC-funded research project on a medical and technical aspect of wine consumption entitled (ADF02/01) *The identification and measurement of potential allergens in wine.*

The identification and measurement of potential allergens in wine

A collaborative project between the Department of Allergy, Asthma and Clinical Immunology, The Alfred Hospital/Monash University and The Australian Wine Research Institute commenced on 1 July 2002. The project is funded by the GWRDC through The Alfred Hospital and Creina Stockley is the project supervisor and Professor Robyn O'Hehir is the principal investigator. The project was developed in response to labelling requirements for potential allergens introduced on 14 December 2002 by Food Standards Australia New Zealand, where use of the proteinaceous processing aids casein, egg white, isinglass, milk and milk products in winemaking requires declaration of use on the label of each wine and wine product.

The project comprises two sections. The first section is the determination of detectable allergenic proteins in wine by establishing an *in vitro* functional assay to determine if wines fined with the proteinacous processing aids are capable of activating blood basophils from subjects with known sensitivity to milk, egg, fish, or nuts, and by establishing a panel of sensitive and specific antigen-capture ELISA to detect and measure the processing aids casein and potassium caseinate, egg white, isinglass and milk in final bottled wine. The second section is a double-blind placebo-controlled clinical study of fined wines in subjects with confirmed sensitivity to eggs, fish, milk or nuts.

A panel of 113 Australian wines was collected and coded by the AWBC and AWRI for blind analysis by The Alfred/Monash University investigators, and included at least 20 wines that had been fined with: egg white or had whole egg added; casein or potassium caseinate; isinglass; milk; or had non-grape derived tannin added. Four control non-fined wines were also collected.

Sensitive enzyme linked immunosorbent assays (ELISA) are being developed to detect residual fining agents in wine. An ovalbumin (egg)-specific ELISA was established using commercial monoclonal and polyclonal antibodies and used to screen the above panel of 100 wines. Apart from the two wines to which whole eggs had been added rather than being fined with egg white proteins, the concentration of ovalbumin was below the detection limit of the assay (1 ng ovalbumin/L). Antibodies to other processing aids are currently being generated to develop additional ELISA.

Further investigation of potentially detectable allergenic proteins in the wines has been obtained from *in vitro* basophil activation tests (BAT) using flow cytometry. BAT have been developed and optimised for use with wine and the processing aids. Challenge subjects with sensitivity to the relevant food allergens were recruited to provide a blood sample, such that analysis of the 1113 wines using BAT occurred in tandem with the clinical challenges of subjects.

Thirty-seven challenge subjects were recruited, clinically characterized, and compared to a group of 11 healthy subjects without a history of food or wine reactions and in the absence of specific IgE to any of the study allergens. As milk allergy is rare in adults, only one milk allergic subject could be identified for this study. The subjects were challenged with the relevant fined wine and with a control unfined wine on separate occasions and monitored clinically for a period of two hours after challenge. A diary card was completed over the six days following wine consumption. Data have been analysed correlated with the data obtained from the *in vitro* BAT studies conducted, and a manuscript entitled *Potential allergens in wine: double-blind placebo-controlled trial and basophil activation analysis* has been prepared and submitted for publication to the *Journal of Allergy and Clinical Immunology.*

Together the interim findings are consistent with a lack of residual potentially allergenic processing aids in final bottled wine manufactured in Australia at a concentration that could cause an adverse reaction in fish or peanut/tree nut allergic subjects. Wines to which whole eggs are added cannot be included in this conclusion; the two such wines in this survey panel contained detectable ovalbumin and were not tested in clinical challenge. Moreover, only a limited number of milk allergic (one) and egg allergic (five) subjects could be recruited for this study due to the paucity of these allergies in adults, and a follow-up study using serum from children with these allergies in a stripped basophil activation assay is being undertaken.

Viticultural practices: ensuring best practice in relation to the use of agrochemicals and other viticultural production; information and determination of the effect of selected viticultural practices on grape and wine composition

Staff
Dr Sally-Jean Bell

The objectives of the work of the Viticulturist is to assess and disseminate information from a variety of sources where viticulture interacts with oenology; and to participate in viticultural research on winegrapes in relation to wine quality.

During 2004/2005 the Viticulturist responded to 547 enquiries.

Agrochemicals
Eleven thousand copies of the AWRI's annual publication, *Agrochemicals registered for use in Australian viticulture 2004/2005* were produced and the booklet was made available on the AWRI website. The booklet was distributed with the *Australian New Zealand Grapegrower and Winemaker, Technical Review* and the *Research to Practice*™ IPM and Spray application manuals. The tables were featured in *Australian Viticulture and the Grapevine Management Guide 2004/2005* (Somers et al. 2004). The 2004/2005 MRLs for Australia's major export markets were updated for the AWRI website. The Viticulturist and Jelka Software further developed the agrochemical database and updated it for 2004/2005. The Viticulturist and Trevor Wicks (SARDI) were successful in gaining funding to run two residue trials in the 2004/2005 season. Six agrochemical updates were prepared for industry email subscribers.

The common spray diary format, developed in conjunction with industry for the 2004/2005 season has now been accepted as the industry minimum standard for 2005/2006. The format and explanations of the spray diary terminology and other relevant information are available on the AWRI website.

The 2001/02 Locust Fact sheet was updated in conjunction with PIRSA *(Locust control in Viticulture — Spring/Summer 2004).*

Other activities
The Viticulturist participated in the AWRI Roadshow visit to Toowoomba (QLD) and at the 12 AWITC she facilitated a 'Salinity' workshop; gave a presentation entitled 'Modification of red grape phenolics by viticultural management — A tale of two seasons' (at three 'Red Wine Phenolics' workshops) and prepared a poster entitled 'Impact of season and viticultural practice on red grape phenolics' (see Appendix 1).

Abstracts of relevant articles for *Technical Review* were prepared. Three invited presentations were made at Farmer Johns Viticulture Seminar (The role of MRLs in selling quality wine), Orlando Wyndham Winemakers Post Vintage Review (Vineyard nitrogen) and the Interwinery Analysis Group (Vineyard practices and the impact on colour) (see Appendix 1). The AWRI's 50th anniversary review manuscript 'Implications of nitrogen for grapes and wine' was completed.

The research project 'The effect of plant water status and canopy management on the phenolic composition of Shiraz grapes and the resulting impact on red wine quality' has come to a close. A poster and a presentation of data from this trial were prepared for the AWITC poster session and the Red Wine Phenolics workshops respectively (see Appendix 1). Analysis of the final seasons samples were completed and statistical analysis of the results is underway.

Quality Liaison Manager

Staff
Mark Gishen

Mark Gishen remains heavily involved in the collaborative research project evaluating the use of near infrared spectroscopy (NIRS) for the rapid determination of a number of compositional parameters in grapes, must, wine and grape spirit, and continues to take primary responsibility for the project as team leader. The details of this project are reported elsewhere in the Annual Report. New collaborations have been established with the Department of Chemical Engineering at Adelaide University through co-supervision of PhD and Honours students' projects including: alternative tartrate stabilisation, optimisation of winery scheduling, and monitoring of fermentation.

The AWRI continues to provide advice on quality management techniques to industry through the *From grapes to glass* program, which was published in August 1997 and enhanced with a simple HACCP module in 1999. Industry interest remains greatest in the HACCP module — a simple program delivered in a one-day course that incorporates an HACCP-type (hazard analysis and critical control point) food safety plan. This module was designed to satisfy the requirements of the national food hygiene regulations, and meet the needs of the smaller scale businesses in the wine industry. Only one course for the HACCP module was conducted throughout the year, adding another six to the growing list of companies having attended (now totalling 100). The *From grapes to glass* program provides a simple and relatively cheap program that uses a staged approach in the attainment of internationally recognised standards, starting from the *Codex* HACCP principles and leading to the full ISO 9000 quality management standard.

Mark Gishen takes primary responsibility for the internal quality management systems of the Analytical Service, overseeing management reviews, documentation, auditing, and corrective actions, and is the Authorised Representative in respect of its NATA accreditation. Validation


Sally-Jean Bell

reports prepared by the laboratory for several new methods were reviewed or approved and these included: the determination by HPLC of piceid (resveratrol glycoside); determination by GC-MS of norisoprenoids (naphthalene, trimethyl dihyronaphthalene [TDN], β-damascenone, β-ionone), monoterpenes (rose oxide, linalool, α-terpineol, nerol, geraniol), ethyl esters (ethyl-butyrate, -isobutyrate, -hexanoate, -octanoate, -decanoate), tebuconazole, hexaconazole, prothios, 2,4,6-tribromoanisole, quinoxyfen; the use of the FOSS WineScan for the determination of density, pH, and the concentrations of TA, VA, alcohol, glucose+fructose, acetic acid, malic acid and citric acid. The Analytical Service continues to participate and excel in both national and international proficiency testing programs for routine wine analysis and for agrochemical residue testing. The quality system of the Analytical Service was externally reviewed this year by NATA and has gained certification and recognition for compliance with both the ISO17025 quality management standard for testing laboratories and the OECD Principles of Good Laboratory Practice respectively.

Mark Gishen is the AWRI's representative on the Winemakers' Federation of Australia (WFA) working group known as the Legal Metrology Group. This group was formed in response to a proposal put by the National Standards Commission (now National Measurement Institute) and aims to develop a metrological control system for measurement instruments used by wineries for the receival of and payment for winegrapes. The group has prioritised the various areas to be addressed and has commenced a work program to progress its aims. Mark Gishen is also liaising with another of WFA's committees, the packaging Committee, as part of the process of reviewing and updating the industry's *Code of Good Manufacturing Practice* in collaboration with Creina Stockley.

Provision of technical information: facilitating innovation through customised information delivery to industry practitioners and researchers

Staff

Rae Blair, Catherine Daniel, Ingrid Oats, Melissa Francis

The John Fornachon Memorial Library holds the largest collection of wine technical literature in Australia. The Library's principal responsibility is to provide technical information to the Australian wine industry and to the researchers of the AWRI. The Library is also used extensively by other groups such as students, institutional researchers, government bodies and private companies (see Table 9 for requests for information serviced during the year).

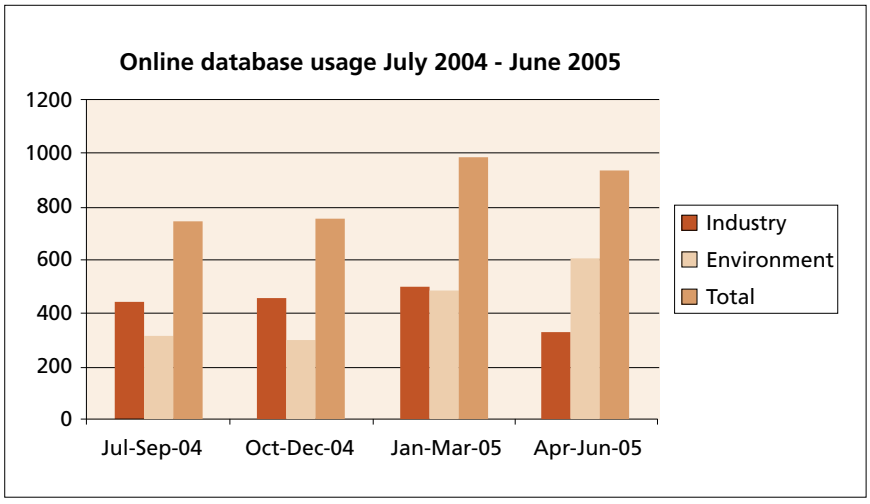


Figure 9. Online use of the AWRI's 'Industry' and 'Environment' databases from 1 July 2004 to 30 June 2005

Information and document delivery services

The Library has excellent access to international databases, particularly in the fields of science, technology and medicine. If requested, the Librarian, Catherine Daniel, will carry out online searches on commercial databases on any appropriate topic (on a fee-for-service basis). Alternatively, Library staff can provide, free of charge, a report of relevant articles indexed on the Library's in-house databases.

The Library's traditional focus on being a centralised 'one-on-one' service provider has shifted to meet the demands for 24-hour, 7-day per week access to industry-specific trade and research literature that is of interest and relevance to the Library's key clientele. The Library, whilst still providing the essential personal service, has focussed on expanding and making more valuable its web-accessible database. While the Library continues to enjoy strong support for its traditional suite of services, the Library's electronic resources, particularly the web-accessible database, are being used increasingly by industry as indexes to wine and grape literature that is already held in personal and company collections. An increasing proportion of the Library's resources are, therefore, devoted to the maintenance and development of such systems (number of records shown in Table 11). Table 9 provides information on the number of enquiries serviced by Library staff during the year. Whilst there has been a decline is demand for the more traditional services offered by the Library, there has been a steady increase in the use of the Library's electronic services.

Document delivery

The Library can supply either books or photocopies from its collection or obtain such items for wine industry clients through the interlibrary system. Patents or standards can also be ordered. Electronic ordering and delivery services mean that most interlibrary requests are fulfilled within five days. Charges apply for the supply of some items.

Specialised information services

The Library staff continue to be actively involved in the production of specialised information products for the benefit of the wine industry, such as the annual and web-based editions of the *Agrochemicals registered for use in Australian viticulture,* the bi-monthly print and electronic editions of *Technical Review,* and several in-house technical information databases.

Table 9. Summary of information requests during 2004/2005

	Wine industry		Staff		Other[6]		Total		% change
	2005	2004	2005	2004	2005	2004	2005	2004	2005
Information requests	1089	1151	966	1035	1319	1602	3559	3788	(6%)
Interlibrary loans:									
requests sent[1]	56	53	479	514			535	567	(6%)
requests received[2]							39	83	(53%)
Technical Review requests[3]							90	189	(52%)
Technical Review articles forwarded[4]							500	915	(45%)
Articles forwarded[5]							396	869	(54%)
Number of AWRI publications forwarded							275	627	(56%)
Articles photocopied in JFML							2354	3899	(40%)

1 Staff at the JFML sent a request to another library for an article.
2 Requests received by the JFML from other libraries for articles from our collection.
3 Number of requests received for articles published in the *Technical Review.*
4 Number of articles forwarded (usually more than one article is requested).
5 Number of articles forwarded, excluding staff publications.
6 90% of 'other' requests come from students and Government sources.

Daniel Ramon
(Spain)

Agrochemicals Grid

As reported elsewhere in this Annual Report, Dr Sally Bell and Catherine Daniel prepared the fourteenth edition of the *Agrochemicals registered for use in Australian viticulture*. All levy payers receive a printed copy of the revised edition automatically, and the web-based edition (http://awri.com.au/agrochemicals/) is updated on a regular basis.

Technical Review

Technical Review is received by all *Wine Grapes* and *Wine Research Levy* paying organisations in Australia and, through subscription, by government and other organisations and individuals, both in Australia and overseas. *Technical Review* provides progress reports to the industry on the AWRI's research as well as updates on relevant conferences, regulatory amendments and medical issues. *Technical Review's* 'Current Literature' section provides citation details and abstracts of recently published technical and scientific articles. Recipients of *Technical Review* may order articles featured in the 'Current Literature' section via a request form available within each issue. Restricted password access to *Technical Review* is also available on the AWRI's website (http://awri.com.au/technical_review/latest_issue/). Dr Barbara Hardy AO and her family continue to support the publication of *Technical Review* through regular generous financial contribution to the Thomas Walter Hardy Memorial Trust, and their ongoing support is gratefully acknowledged.

The collection of the 2004/2005 issues of *Technical Review* has been made available via a CD ROM and distributed free of charge to *Wine Grapes* and *Wine Research Levy* paying organisations. A simple search mechanism within the CD ROM facilitates fast access to technical notes, current literature abstracts and other matters of interest published throughout the year within the six issues.

Email service

The Email Advice and Information on Technical Issues Bulletin service continues to be a fast and cost-efficient way of disseminating important technical information to interested members of the Australian wine industry. There are 1,324 email addresses recorded to receive the email bulletins, and interested members of the Australian wine industry should submit their email address (to Rae.Blair@awri.com.au) should they wish to receive the email bulletins. Nine email bulletins were issued during the year and are shown in Table 10.

Table 10. Email bulletins sent during 2004/2005

Date	Bulletin topic
15/9/04	Rescheduling of products containing the active constituent Procymidone
20/9/04	October *Technical Review* now available online
23/9/04	Chemical control of locusts in vineyards
1/11/04	AWRI roadshow and workshops in Toowoomba November/ December 2004
19/11/04	Changes to the procymidone withholding period and new instructions for use
7/12/04	AWRI roadshow in Griffith NSW, January 2005
31/1/05	Procymidone update
7/2/05	PMS and Marvel update
22/3/05	Hunter Valley workshop program

Library collection

A total of 71 monographs and 4 conference proceedings and over 3,900 new records were added to the library databases during the year.

The Library subscribes to 54 journals and receives approximately 70 annual reports, journals and newsletters through exchange and donation. The Library also maintains a collection of over 24,000 reprints.

Library databases

A single search screen provides access to the Library's collection of over 48,000 books, conference proceedings, scientific, technical and medical reprint articles which are indexed on the Library's database catalogue; the bibliographic details of the Library's collection of the European Union wine legislation and details of the library's journal holdings are maintained on separate in-house databases.

The Librarian provides reports, either on particular subjects or authors, listing the records retrieved from any of the Library's in-house databases. A summary of the size of the Library's catalogue and information databases is given in Table 11.

Table 11. Number of records on the Library's catalogue, information and web-accessible databases

Library catalogue databases	
AWRI_Database: Books, conference proceedings, theses, scientific and medical papers	48,113
JOURNALS: journals, newsletters, statistics and annual reports	400
Library information databases	
REGS: European Community wine legislation	393
ISYS – full text retrieval database covering	
United States of America *Federal Register*	879
Web accessible database 'Industry' (with searchable abstracts)	32,684
'Environment'	436

The Library provides access to its databases via the internet to Australian winemakers and grapegrowers paying the *Wine Grapes Levy* or the *Wine Research Levy.* The restriction in access is enforced to comply with copyright approvals obtained from the various publishers whose journals are the source of the abstracts that are accessible via the database. Library staff members continue to edit database records to post onto the Library's web database, on an ongoing basis.

Participation at the Twelfth Australian Wine Industry Technical Conference

The Librarian attended the 12th Australian Wine Industry Trade Exhibition in Melbourne last year in a shared booth with staff from the Australian Wine and Brandy Corporation's Wine Industry Information Service.

The Librarian spent the four days demonstrating the AWRI Library database to Conference and Exhibition delegates and taking contact details to facilitate subsequent forwarding of access requirements to interested delegates following the Conference. Many delegates, particularly grapegrowers, were unaware of the AWRI Library and, indeed, of its electronic services. Delegates were given the opportunity to search the database themselves for topics of interest to them and many were genuinely surprised at the amount of information available.

The three posters prepared by the Library staff (see Appendix 1) also generated a huge amount of interest, with many delegates coming to see the Librarian about access to the AWRI's services after reading the AWRI information services posters.

Over the four days, over 100 delegates requested that the Librarian forward them the access details to the library's database. Many delegates also felt that the AWRI's website would be greatly improved by having a problem-solving or issues section that specifically targets the needs of grapegrowers. With over 80% of the delegates who requested access to the AWRI's services being grapegrowers who pay the levy, but are not listed on the Australian government's levy list, this is an issue which the AWRI needs to address for its service to be available to all members of Australian wine and grape industry.

Wine and the environment database

The Librarian and the Manager — Communication and Information Services also prepared a poster for display at the Third Australian Wine Industry Environment Conference held in Adelaide in February 2005 (see Appendix 1). The poster provided details about the AWRI's Wine and Environment database, and how access can be achieved.

The John Fornachon Memorial Library Endowment Fund

The AWRI acts as the Trustee of this fund, which was established in 1969 by donations from winemakers and friends of the late John Fornachon, the first Director of Research of the Institute. The Library is funded by an annual grant from the Grape and Wine Research and Development Corporation, together with the income generated from investment of the Endowment Fund.

Acknowledgements

The AWRI wishes to thank all individuals and companies who contribute to the collection through donations or exchange agreements. The support of the following persons and organisations that have donated books, journals or photographic material is acknowledged:

Australian Bureau of Agriculture and Research Economics, Australian Dried Fruits Corporation, Australian Wine and Brandy Corporation, Australian Wine and Brandy Producers' Association, Commonwealth Scientific and Industrial Research Organisation, Dr B.G. Coombe, Dr P. May, Petaluma Australia, K.F. Pocock, Dr B.C. Rankine, Viticultural Publishing Inc., Winemakers' Federation of Australia Incorporated.

Communication and Information Services

Staff
Rae Blair

General activities
The Manager — Communication and Information Services is responsible for the achievement of the performance targets of the John Fornachon Memorial Library; communication issues for the broader AWRI; provides editorial services (along with staff within the John Fornachon Memorial Library) and specifically for AWRI papers for non-refereed publications; production of corporate publications; management of the AWRI website; copyright issues; and for the performance of the Australian Wine Industry Technical Conference Inc. (in her role as Public Officer, Treasurer and Conference Manager). The reports on the performance of the Twelfth Australian Wine Industry Technical Conference is included elsewhere in this report, as is the performance of the John Fornachon Memorial Library under *Provision of technical information: facilitating innovation through customised information delivery to industry practitioners and researchers* report above. The Manager is an observer at the AWRI's Council meetings.

In February, the Manager participated in the AWRI's Strategic Planning Day, moderated by Dr John Stocker, which was attended by senior AWRI staff and some of our major stakeholders. Since that time, the Manager has been contributing to the finalisation of the AWRI's ten-year Business Plan, which has received wide input from many sources both internal and external to the AWRI.

The Australian Wine Research Institute contributes a regular column in the *Australian and New Zealand Wine Industry Journal*. This journal is published bi-monthly and the Manager is responsible for the editing and delivery of the AWRI's contribution (details of the articles published are in Appendix 4). The Manager also contributed regular articles to the AWRI's bi-monthly publication *Technical Review*.

Trust fund sponsorships
The Manager — Communication and Information Services manages the activities of The Stephen Hickinbotham Memorial Research Trust. During the year the Research Committee of the Trust approved the sponsorship of Dr Nicolas Vivas from France *(Universite de Bordeaux I-CESANO)* to give a presentation at the 12 AWITC (28 July 2004, Melbourne Vic). Dr Vivas' presentation to the 1,680 delegates was titled: *Reactions and occurence of wines' polyphenols evolution during oxidative process in oak*.

The Trust Fund further agreed to sponsor Dr Hélène Fulcrand (INRA, Montpellier, France) to give a presentation at the ASVO seminar *Advances in tannin management* on Thursday, 6 October 2005 in Adelaide (with video-conference link to WA and Vic). Dr Fulcrand's presentation is titled: *Tannins: from reactions to complex supramolecular structures. What do we know today?*

The Managing Director and the Manager — Communication and Information Services met with Dr Barbara Hardy and Mr Bill Hardy to discuss expanding the activities of The Thomas Walter Hardy Memorial Trust Fund. The Trust Fund regularly contributes funds towards the publication of the AWRI's *Technical Review*. It was agreed that the Trust Fund would also sponsor Session 6 at the 12 AWITC, *Environmental management: treading lightly,* which was presented on Tuesday, 27 July 2004 in Melbourne.

The support from both of these Trust funds is acknowledged and very much appreciated, as facilitators of information dissemination of benefit to the Australian wine industry.

AWRI's 50th anniversary activities
The achievement of this significant milestone was seen as an excellent opportunity for the AWRI to broaden its extension activities during the year. Several initiatives were undertaken and some of these will continue until the end of 2005:

AWRI 50th anniversary seminar program
A series of 17 seminars have been scheduled in all states and the ACT and are coordinated by the Manager — Communication and Information Services with assistance from the Personal Assistant to the Managing Director. Our first seminar was held in Adelaide on 14 June, which was followed by Renmark, Wodonga, Bendigo and Melbourne. Each seminar has been very well attended and excellent feedback has been received from people who have a lot of experience in the industry and from those who are new to the industry. Nine presentations are given at each venue, which includes a short presentation from a representative from the Grape and Wine Research and Development Corporation. Not only is significant goodwill generated within the regions the seminars are held in, the AWRI staff members in turn receive feedback and information from attendees which is immediately applied back at the AWRI.

In the next financial year, the anniversary seminars will be held in Griffith, Hobart, Launceston, Hunter Valley, Canberra, Cowra, Coonawarra, Mildura, Margaret River, Mount Barker, Swan Valley and finally Toowoomba at the end of November 2005.

AWRI commemorative publications
Fifteen review articles have been prepared by AWRI staff members. The following ten papers were published in the *Australian Journal of Grape and Wine Research* volume 11(2):

Grape and wine biotechnology: challenges, opportunities and potential benefits
I.S. Pretorius and P.B. Høj

Olfaction and taste: human perception, physiology and genetics
J.H. Sweigers, P.J. Chambers and I.S. Pretorius

Determining wine aroma from compositional data
I.L. Francis and J.L. Newton

Better wine for better health: fact or fiction?
C.S. Stockley, P.B. Høj

Yeast and bacterial modulation of wine aroma and flavour
J.H. Swiegers, E.J. Bartowsky, P.A. Henschke and I.S. Pretorius

***Oenoccocus oeni* and malolactic fermention — moving into the molecular arena**
E.J. Bartowsky

Contributions of mass spectrometry in The Australian Wine Research Institute to advances in knowledge of grape and wine constituents
Y. Hayasaka, G.A. Baldock and A.P. Pollnitz

Analysis of grape and wine tannins: methods, applications and challenges
M.J. Herderich and P.A. Smith

Preventing protein haze in bottled white wine
E.J. Waters, G. Alexander, R. Muhlack, K.F. Pocock, C. Colby, B.K. O'Neill, P.B. Høj and P. Jones

Compounds causing cork taint and the factors affecting their transfer from natural cork closures to wine — a review
M.A. Sefton and R.F. Simpson

Two review papers will be published in the *Australian Journal of Grape and Wine Research* Volume 11(3):

Grape and wine analysis – enhancing the power of spectroscopy with chemometrics
M. Gishen, R.G. Dambergs, D. Cozzolino

Nitrogen in grapes and wine
S.J. Bell and P.A. Henschke

One review paper will be published in the *Australian and New Zealand Wine Industry Journal* (September/October 2005):

Trends in the composition of Australian wine 1984–2004
P.W. Godden and M. Gishen

All of the above papers will be contained within a commemorative booklet published by The Australian Wine Research Institute (compiled by the Manager and with assistance from Melissa Francis). The following two papers will also appear:

Team reports

Overview of The Australian Wine Research Institute 1955–2005
R.J. Blair

The John Fornachon Memorial Library — under the microscope
M.E. Francis, C.G. Daniel, I.B.M. Oats, R.J. Blair

This commemorative publication will contain a foreword prepared by I.S. Pretorius and R.E. Day and will be sent to all Australian levy payers with the AWRI's 2005 Annual report, and also sent to each person who attended the anniversary seminars.

Wine Innovation Cluster (WIC)
Since 2003, The Australian Wine Research Institute has been investigating options to improve its physical infrastructure. On 25 August 2004, Peter Høj presented to the South Australian Wine Industry Council in the presence of the South Australian Premier and Treasurer a concept for a new home for the AWRI with space for The University of Adelaide and Provisor and linked to CSIRO Plant Industry (a WIC concept). During September and October 2004, Provisor and the AWRI had meetings with SARDI to seek support of the concept.

During September 2004, a business plan for the concept was completed by Deloittes. Preliminary plans were drawn up and legal advice sought with regard to operational issues. The agreed concept was costed at $20.7 m, for an area of 6,486 m^2 and an involvement of four parties.

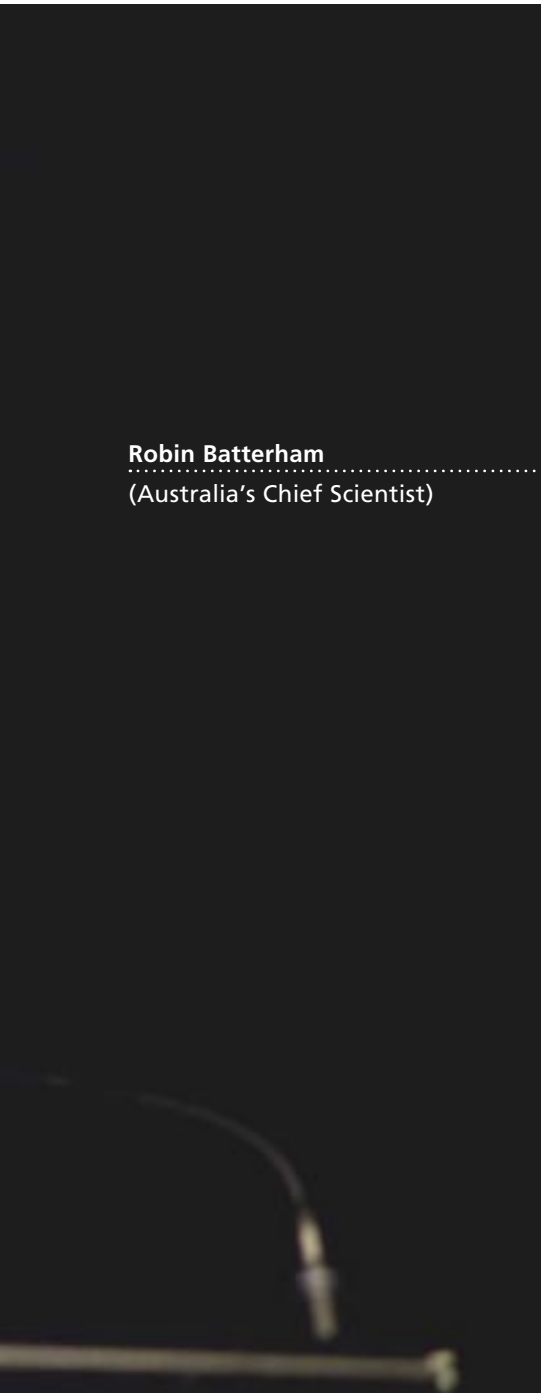
At the South Australian Premier's request, SARDI prepared a request for funding for the WIC from the South Australian State budget. The request for funding from the State Government was $11.5 m to support the $20 m option. Due to the deadline for submission of the budget request, all options for the WIC, including decanting options, had not been fully finalised.

In May 2005, the State Government agreed to assign state funds of $9.5 m. At this stage, the parties to the WIC increased with the inclusion of SARDI, and the University of Adelaide's space requirements had still not been totally finalised. A WIC Steering Committee was formed and chaired by Robin Day (Chairman of AWRI). The granting of the funds came with a timing imperative for commencement (early 2006) of construction.

In June/July 2005, the South Australian Minister for Agriculture, Food and Fisheries requested his representative Chair the WIC Steering Committee, and nominated Mr Peter Hayes for this position. Since the end of the financial year, the following developments have taken place:

- Site options for the WIC building were narrowed down to two sites: one option involved demolishing the existing AWRI buildings and the other option involved construction of the new building to the east of the CSIRO Plant Industry building on a 'greenfield' site.

  The first option was subsequently discounted due to the lack of appropriate 'decanting' space for AWRI staff to continue its activities during the demolition and construction phase; the prohibitive cost of moving and setting up the AWRI facilities twice; and the cost of the loss of an asset in demolishing the AWRI buildings.



Robin Batterham
(Australia's Chief Scientist)

- The WIC will now comprise a 'three-building cluster'. This will involve an extension being built to the CSIRO Plant Industry building and accommodating Provisor (WIC 'West'); a new building being built just east of CSIRO, on the Waite Precinct, which will accommodate the AWRI, The University of Adelaide and SARDI (WIC 'Central'), and incorporating the Hickinbotham Roseworthy Wine Science Laboratory (WIC 'East').

- The AWRI will take out a commercial loan, serviced by the activities of its Analytical Service, to contribute to the costs of construction.

Staff directly involved with this process at the present time are:
WIC Steering Committee: Sakkie Pretorius and Rae Blair
(and the following sub-committees reporting to the Steering Committee):
WIC 'Central' Project Control Group: Sakkie Pretorius, Rae Blair, Holger Gockowiak
WIC Science Integration Committee: Sakkie Pretorius, Markus Herderich
WIC 'Central' Technical Reference Group: Markus Herderich, Peter Godden, Rae Blair

Subject to the cost of the building, and the AWRI being able to fund its share of WIC 'Central' the AWRI hopes to be able to move into its new home mid/late 2007.

Analytical Service

Staff

Peter Eichinger, Matthew Cream, Randell Taylor, Sandra Lloyd-Davies, David Boehm, Danielle Leedham, Maria Mills, Heather Brooks, Belinda Bramley (to September 2004), Stella Kassara (part-time), Carol Sigston, Slavko Bakavac, Daniel Tynan, Steve Smith and Jelena Jovanovic (part-time)

This has been another very busy year, due to a steady high volume of work being processed by the Analytical Service. The weather conditions during the vintage were very favourable for the development of fruit and consequently we did not have a large 'spike' in our workload.

This year's challenges have arisen through the continued high growth in the number of 'budget' tests affecting profitability, some equipment failures and efforts to resource new and improved services. In spite of these difficulties, considerable progress has been made. We have managed to significantly reduce our overall turnaround times on several analyses. This was only possible because we targeted our efforts to areas where bottlenecks had been identified, such as grape colour measurements. Overall, the Analytical Service conducted approximately 64,700 individual tests on wine and grapes in 2004-2005. While the number of tests has grown, the number of data points has grown marginally to almost 94,800. This reflects a change in the composition of the work.

Storage of records and samples continues to be a problem. Capacity has been dramatically improved with the purchase and installation of an upright refrigerator (1500L) and an upright freezer (1500L); a major clean up of the cellar freezer; and the installation of two large bottle racks. The extra space has an added benefit in that access to samples for disposal, or use is improved. Records held internally for longer than one year (approx 100 standard archive boxes) have been moved to a Records Management facility. The facility was audited to comply with our GLP requirements. It is now almost impossible to expand services further due to the physical constraints of our existing building.

Two major achievements during the year have been achieving GLP accreditation and successfully completing the NATA audit. As a result of the audit there were a number of minor conditions, all of which have been achieved. We are pleased to have three new signatories accepted by NATA: Steve Smith, Danielle Leedham, and David Boehm. Accreditation of the Winescan method has been approved and the FIA instrument has been inspected. However, due to the lack of a NATA person to check the measurement uncertainty for hydrometers, approval of the accreditation was delayed. The Winescan will come into full operation early in the new financial year.

To maintain accreditation and to ensure the smooth migration of the existing service from its present location to a new site, presents many challenges for the future. Paramount to the success of the relocation will be the detailed scheduling of any relocation. To complete the move to the new building, including set up and calibration of relocated equipment, resources and services, and re-certification by NATA within one week will be required to avoid undue inconvenience to our clients. Some instruments, such as the Fara Cobas might not survive relocation as any damage is irreparable due to the age of the equipment and so contingencies are being developed to avoid any problems.

There have been few staff changes in the past 12 months. Due to the time of the departure of some staff it has been difficult to find suitable people to cover and train them for the range of services offered by the laboratory, as some of the work was seasonal. The trace analytical laboratory supervisor resigned in November and was replaced by Mr Randell Taylor. A new person has been employed in the Trace Analytical laboratory, Ms Caroline Sarneckis, who is a recent Flinders University graduate. She replaces Ms Brambly who was trained (paid by AS) to perform sensory work and is now working full-time in the sensory group. Steve Smith, who has a Graduate Diploma in Oenology, is employed in the Analytical Service and will be useful for his wide ranging experience at the bench and winemaking experience. Mr Anthony Marafioti was a very capable employee until his resignation in June.

Isabelle Lesschaeve
(Canada)

All new staff members have been trained in a range of skills. Consequently, we now have redundant capabilities for most test methods that are used throughout the year. Ms Carol Sigston and Ms Danielle Leedham have been on the NATA "quality in the microbiology laboratory" course, as no experienced micro analysts were left with knowledge of quality control issues. The Industry Development and Support staff (including Matt Holdstock) provided some support in practical identification techniques, so the training course added to the knowledge base they had acquired.

Overall performance

The performance of the laboratory has been compared on a year by year basis in Table 12 on selected tests. On this basis, the performance has been satisfactory, with the number of export certificates higher than last year, but with a drop in Japanese certificates and comparable overall numbers of routine analyses in the analytical lab. There was a significant overall rise in many of the trace analytical laboratory tests, of which many generated a large number of data points.

Table 12: Comparison of selected tests performed by year

Year	Test or certificate	
	Total number of data points	Total number of tests
00/01	68543	46037
01/02	62354	48314
02/03	80572	53932
03/04	91840	56181
04/05	94766	64705

Analytical laboratory

The changes in the number of export certificates issued has been minor. Enzymatic tests such as malic acid has dropped significantly, while glucose/fructose is marginally ahead. Volatile acidity, including enzymatic acetic acid determinations rose significantly. Other tests such as alcohol determinations, sterility and sulfur dioxide measurements increased significantly.

The high volume sulfur dioxide and volatile acidity measurements continue to be performed manually. The validation of the automated sulfur dioxide methods are almost complete with over 250 samples having been cross validated using both the manual and automated methods. There will be considerable increase in capacity to meet peak demand such as on receipt of large numbers of sensory samples. The labour requirements will be greatly reduced, compared to the old method, which means that new development work can commence on other tests. The reagent and labour costs for volatile acidity will be lower than for enzymatic acetic acid test kits. These methods are due to be sent for accreditation in September and so we expect to be able to have approval by December.

Commercial closure trial testing was conducted for the 24 and 30 month time points and went well. A number of small projects from loss adjusters were also conducted.

NATA audit

The NATA audit was successfully completed in February 2005 and as a result the Winescan methodology was finally accredited.

We have two new signatories in the Analytical Service: Danielle Leedham and Steve Smith for all routine analytical laboratory tests, and David Boehm for HPLC analyses in the trace analytical laboratory. It is important to recognise that all of the signatories for the Analytical (routine) laboratory methods now have signatory status for the Winescan methods. The presence of additional signatories in the routine laboratory will streamline reporting when the Analytical laboratory supervisor, Matt Cream, is not available.

Trace Analytical Laboratory

Mr Greg Ruediger completed the GLP documentation. He left as the TAL supervisor in November 2004 and is currently in China. His supervisory duties have been given to Randell Taylor, who is performing very well in that capacity. Randell Taylor and Heather Brooks will be given GLP training early in the new financial year which will be of particular benefit should the Service be requested to be involved in a series of residue and winemaking trials next year.

There has been continued growth in 'Brett' screening and the headspace SPME gc/ms is now operating at full capacity. In addition, we have extended the headspace SPME methodology to include chloroanisoles (espTCA) (cork taint) and tribromoanisole (TBA).

We have improved the range of residues in the multi-residue gc/ms test method. Hexaconazole, prothiophos and tebuconazole have been formally added to the NATA accredited

Steve Guy
(AWBC)

David Wollan
(Wine Network Australia)

Daniel Ramon
(Spain)

method. We have commenced validating an additional three compounds for inclusion into the method, namely quinoxyfen, indoxacarb and dimethomorph. Testing for most of these compounds was available in specific individual tests, using customised extraction procedures and separation techniques. The existing method appears to be suitable for quantification of these additional compounds. In effect, we will be providing a more cost effective test. It will also assist us to improve turnaround times as we will use one extraction method and one gc column for all these analyses. Furthermore, there will be less instrument downtime as we will have few dedicated test methods. This instrument is working below full capacity, as some methods have now been transferred to the instrument with the Gerstel headspace autosampler. This frees up sample preparation space, which is very limited, and the analyst's time.

Samples suspected of being contaminated with rhodamine coloured brines have been processed by the Trace Analytical Laboratory staff. This had been a problematic area in terms of achieving adequate turnaround times. However, access to a new LC/MS$^{(n)}$, the Finnigan LCQ Deca is expected to remove the problems related to capacity shortages. However, further training of Analytical Services staff is essential to meet the ongoing growth in demand and mass spectrometrist's absences (e.g. annual leave/conferences).

Finally, an extensive industry survey with the AWBC was commenced in early December 2004. We coordinated the program with Helen Berden (AWBC), and were able to complete the task in late May 2005, on-schedule.

Administration and Client Services

Administration is being led by Sandra Lloyd-Davies, who continues to ensure all database issues are addressed with our external IT contractor. All Administrative procedures have been upgraded, with an emphasis on ensuring all OHS&W issues and any matters that will affect the LIMS implementation are fully covered. Some of the problems encountered will be covered later in the section on the LIMS system. Ms Lloyd-Davies is now coordinating our Advertising campaign.

Fees

New fees were introduced in November 2004 and ca 7.5% increases across the board were required to be implemented due to significantly higher administration/service fees and small increases in labour costs.

In the New Year, a number of laboratories where we sub-contract work have changed their fee schedules. In most cases, the cost of an analysis is very similar to before, but a batching or sample submission/lodgement fee has been introduced. These will be passed on in the next fee schedule.
An unfortunate consequence is that some contract analyses will almost double in price.

Due to our very limited space, old reports and other records which are more than one year old, are now stored off-site. Clients requesting these old reports (more than one year old) will now be charged at a much higher rate, to cover significant retrieval costs. It should be noted that extended on-site record storage is not planned for in the new building and is in line with most commercial analytical labs.

General activities

Marketing and advertising

- The series of advertisements developed by Geoffrey Reed Communications won the top award for the best Magazine Campaign in the Adelaide Advertising and Design Club's 2004 awards.

- The Analytical Service was again pleased to sponsor the Best Riesling Trophy at the Royal Adelaide Wine Show in September 2004. The trophy was presented by the Analytical Service Manager, Dr Peter Eichinger.

- We provided significant sponsorship to the 2nd Pinot Noir workshop in Victoria through sample analyses.

Legal matters

Procedures have been initiated to ensure the integrity of all data and results, especially where the analytical results are likely to form part of a legal action or insurance claim. Document trails have been improved by placing documentation in lockable archival cabinet and samples stored in the compactus located in the cellar (and movement recorded). This will enable us to deal with complex queries more easily and provide an auditable trail should questions of sample integrity arise.

New Terms and Conditions have been prepared and placed on the AWRI's website. These were designed to cover all issues that have arisen regarding potential litigation and concerns from our insurance broker. The drafting of the terms and conditions took about four months to complete.

Laboratory Information Management System (LIMS)

A new LIMS server has been commissioned and our IT manager is in the process of developing emergency recovery procedures. The LIMS is currently being customised and we hope to have this completed by mid-October 2005, given appropriate resources. In addition, we will be utilising the services of our external database consultant to speed up this process.

Equipment

This year we have purchased a new server for the LIMS system. There were delays in installing the hardware, as we had to relocate the existing consumables and equipment to alternate locations and install the services (power, network cabling and air conditioning) to the small server room.

A new Grindomix was purchased for the Analytical Service to assist with grape colour measurements and dataloggers fitted to areas where GLP work is to be conducted.

A number of instruments are showing signs of prolonged heavy use and have been replaced or are being replaced. These include a new UV-Vis spectrometer and cold stability bath.

Storage and records

Due to storage constraints and to address NATA quality issues, a new 1500L refrigerator and a 1500L upright freezer have been installed. Two bookcases were purchased to hold work in progress samples and some consumables for the trace analytical lab.

Storage is now at capacity in the cellar. Two new bottle racks have been installed and are filled to capacity. Several steel racks have been moved to the cellar to hold other samples and these are also filled.

In part to free up space in the storage room, we firstly consolidated all records, worksheets and documents related to the Analytical Service from the various storage places. Our records were carefully checked and anything that was more than eight years old was discarded. All other records were sorted for easy identification, archived, labelled and those archive boxes that had records prepared more than one year ago were shipped off-site. Once this was achieved, we placed additional shelving in the loft to store relocated NIR paperwork and sample containers.

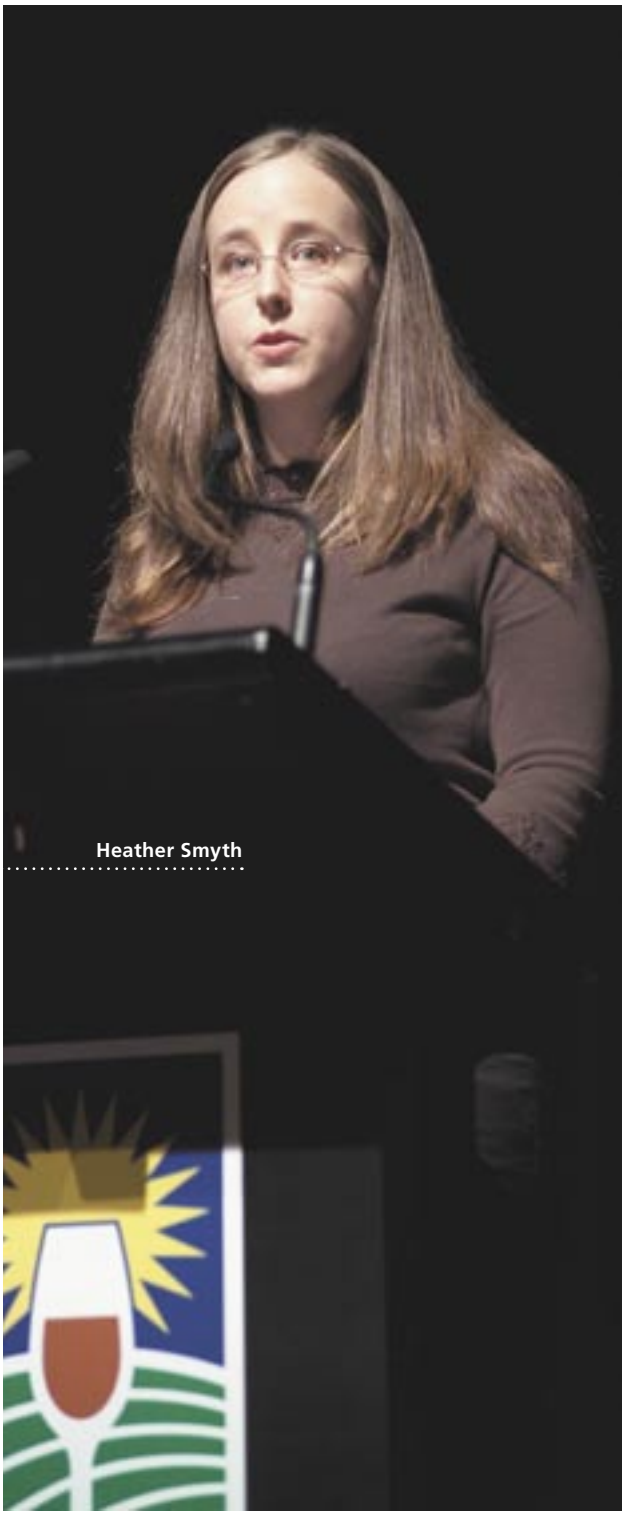
Abridged Financial Report

STATEMENT OF FINANCIAL PERFORMANCE FOR THE YEAR ENDED 30 JUNE 2005	2005 $	2004 $
Revenue from operating activities		
Grape and Wine Research and Development Corporation		
Project funds	5147995	4975689
Equipment	404596	295932
CRCV project funds	666266	601716
Commercial research collaborations	26155	54812
Analytical Service	1761163	1628230
Other revenue	592341	430794
Expenses from operating activities		
Employee benefit expense	5257556	4785401
Analytical & project operating expenses	1199822	1381041
Administration & general services expense	662842	607650
Depreciation and amortisation expense	586692	749248
Travel expenses	204797	141779
Profit from operating activities	686807	322054
Net gain (loss) on disposal of assets		
Motor vehicles	5162	8493
Equipment	(8447)	(4004)
Profit from ordinary activities	**683522**	**326543**
Total changes in equity	**683522**	**326543**

STATEMENT OF FINANCIAL POSITION AS AT 30 JUNE 2005	2005 $	2004 $
Current assets		
Cash assets	1498361	1412016
Commercial bills	2411922	2013437
Receivables	651909	354477
Other current assets	200310	101695
Total current assets	**4762502**	**3881625**
Non current assets		
Leasehold buildings	1447952	1485052
Plant and equipment	1839202	1802870
Investment in Provisor Pty Ltd	650000	650000
Australian Wine Industry Chair of Oenology	840000	840000
Total non current assets	**4777154**	**4777922**
TOTAL ASSETS	**9539656**	**8659547**
Current liabilities		
Payables and accruals	1717773	1849867
Project funds not expended and repayable		
GWRDC	242840	55023
CRCV	6713	55320
Provisions	818019	682109
Total current liabilities	**2785345**	**2642319**
Non current liabilities		
Provisions	117530	63969
Total non current liabilities	**117530**	**63969**
TOTAL LIABILITIES	**2902875**	**2706288**
NET ASSETS	**6636781**	**5953259**
Equity		
Reserves	700000	966750
Retained earnings	5936781	4986509
TOTAL EQUITY	**6636781**	**5953259**

STATEMENT OF CASH FLOWS FOR THE YEAR ENDED 30 JUNE 2005	2005 $	2004 $
Cash flows from operating activities		
Grants and other income	8065020	7946686
Interest received	173214	150489
Payments to suppliers and employees	(7164195)	(6578799)
Net cash provided by operating activities	**1074039**	**1518376**
Cash flows from investing activities		
Payment for commercial bills	(398485)	(759521)
Payments for plant and equipment	(602027)	(465016)
Proceeds from sale of plant and equipment	12818	24409
Payments for investment in Provisor Pty Ltd	0	(323186)
Net cash used in investing activities	**(987694)**	**(1523314)**
Net increase (decrease) in cash held	86345	(4938)
Cash at 1 July	1412016	1416954
Cash at 30 June	**1498361**	**1412016**

RECONCILIATION OF NET CASH PROVIDED BY ORDINARY ACTIVITIES WITH ORDINARY PROFIT		
Profit from ordinary activities	683522	326543
Non cash flows in operating profit		
Amortisation and depreciation	586692	749248
(Profit) loss on the sale of plant & equipment	3285	(4489)
Charges to (reduction in) provisions	189471	54210
Changes in assets and liabilities		
(increase) decrease in inventories	(35765)	14264
(increase) decrease in receivables & prepayments	(360282)	110002
(increase) decrease in sundry creditors & accruals	7116	268598
Net Cash provided by operating activities	**1074039**	**1518376**



Heather Smyth

Appendix 1. External presentations and talks

Staff	Title of talk	Presented to and where	Date
C.S. Stockley	The importance of background diet and disease-state on the potential cardio-protective and other health effects of wines	OIV 2004 Congress, Vienna Austria	5 Jul 04
C.S. Stockley, J.M. Rolland[4], R.E. O'Hehir[4]	Allergen labelling — an Australian wine industry case study		7 Jul 04
C.D. Curtin, J.R. Bellon, D. Capone, P.J. Costello, A.D. Coulter, G.D. Cowey, D. Cozzolino, J.B. Field[1], M. Gishen, P. Graves, K.A. Lattey, E.M. Robinson, I.L. Francis, P.B. Høj[2], M.A. de Barros Lopes[3], P.W. Godden, P.A. Henschke	Incidence and control of *Brettanomyces:* the Australian perspective	Eukaryote Molecular Biology Group, Technical University of Denmark, Copenhagen, Denmark	6 Jul 04
		Faculty of Oenology, University of Bordeaux II, Bordeaux, France	8 Jul 04
D. Cozzolino	Multivariate analysis (chemometrics): a novel approach in modern interdisciplinary sciences	12 AWITC workshop W04 *Hands on in chemometrics,* Melbourne Vic	24 Jul 04
A.D. Coulter	Update of the AWRI *Dekkera/Brettanomyces* spoilage project — survey and sensory data	12 AWITC workshops W07, W27, W47 Brettanomyces — *latest research and control strategies,* Melbourne Vic	24, 26, 28 Jul 04
C.D. Curtin	Update on the latest *Brettanomyces* research		
A.D. Coulter	Tasting of wines spiked with spoilage compounds associated with *Dekkera/ Brettanomyces* during winemaking		
P.W. Godden	Control and monitoring of *Dekkera/ Brettanomyces* during winemaking		
G.D. Cowey, E.M.C. Robinson	Recognition of *Dekkera/Brettanomyces* yeast		
A.D. Coulter, P.W. Godden	Tasting of 'real' *Brettanomyces*-affected wines		
P.W. Godden	Progress and future directions of the AWRI *Dekkera/Brettanomyces* project		
I.L. Francis	Characterising sensory properties of red wines: astringency and mouth-feel	12 AWITC workshops W05, W25 *From grapes to glass: viticultural and winemaking impacts on red wine phenolics,* Melbourne Vic	24, 26 Jul 04
E.J. Waters	The 2002 AWRI red wine screw cap trial		
J.M. Eglinton	Aroma and flavour modification using *Saccharomyces bayanus*	12 AWITC workshops W06, W26, W56 *Winemaking with non-conventional yeast,* Melbourne Vic	24, 26, 29 Jul 04
P.A. Henschke	The nature and use of non-conventional yeasts		
M.A. de Barros Lopes[3]	Hybrid technology: the future of non-conventional yeasts?		
J.R. Bellon	Hybrid technology: the future of non-conventional yeasts?		
S.-J. Bell	Modification of red grape phenolics by viticultural management — a tale of two seasons	12 AWITC workshops W05, W25, W55 *From grape to glass: viticultural and winemaking impacts on red wine phenolics,* Melbourne Vic	24, 26, 29 Jul 04
H.E. Holt	Do winemakers want smaller berries?	12 AWITC workshops W05, W25, W55 *From grape to glass: viticultural and winemaking impacts on red wine phenolics,* Melbourne Vic	24, 26, 29 Jul 04
P.A. Smith	Structure, analysis and colour properties of tannins and other red wine phenolics		
H.E. Smyth, D. Cozzolino, M.J. Herderich, M.A. Sefton, I.L. Francis	Relating volatile composition to wine aroma: identification of key aroma compounds in Australian white wines	12 AWITC, Melbourne Vic	25 Jul 04
M.A. Sefton	Major closure related issues: an Australian research perspective	12 AWITC workshop W19 *Latest developments in cork processing technology,* Melbourne Vic	
I.L Francis	Salinity and wine sensory properties	12 AWITC workshop W17 *Salinity in the vineyard and in the wine,* Melbourne Vic	
E.J. Bartowsky	MLF overview — what can MLF do and possible expectations	12 AWITC workshops W15, W66 *Malolactic fermentation,* Melbourne Vic	25, 29 Jul 04

[1] John Field Consulting Pty Ltd
[2] Currently at the Australian Research Council
[3] Currently at University of South Australia
[4] Department of Allergy, Immunology and Respiratory Medicine Alfred Hospital/ Department of Pathology and Immunology, Monash University

Staff	Title of talk	Presented to and where	Date
P.R. Jones, E.J. Waters	Conscious additions of defined amounts of oxygen to red wine	12 AWITC, Melbourne Vic	26 Jul 04
Y. Hayasaka, G.A. Baldock	Electrospray mass spectrometry: what state-of-art instruments offer wine researchers and practitioners		
M.J. Herderich	Grape maturity and tannins		
G.K. Skouroumounis	The effect of ascorbic acid, closure type and storage conditions on the composition, colour and flavour properties of a Riesling and wooded Chardonnay wine	12 AWITC workshop W22 *Modelling random oxidation in white wine,* Melbourne Vic	
E.J. Waters	Interpreting data from different studies — what does it mean for the practitioner?		
M. Gishen	Integrated management systems (food safety [HACCP]/ OH&S/ environment) for wine grapegrowers	12 AWITC workshop W28 *Quality management — introduction to HACCP,* Melbourne Vic	
I.L. Francis	Wine flavour compounds	12 AWITC workshop W46 *Wine flavour,* Melbourne Vic	28 Jul 04
M. Gishen	Quality management and food safety options for wineries	12 AWITC, W45 *Quality management — HACCP plan development (advanced),* Melbourne Vic	
M.J. Kwiatkowski	The 2002 AWRI red wine screw cap trial	12 AWITC workshop W55 *From grapes to glass: viticultural and winemaking impacts on red wine phenolics,* Melbourne Vic	29 Jul 04
A.D. Coulter	Control and monitoring of *Dekkera/ Brettanomyces* during winemaking	12 AWITC workshop W61A *Wine microbiological spoilage current and emerging issues,* Melbourne Vic	
H.E. Smyth	Objective measures of wine aroma	12 AWITC workshop W71 *Objective measures of grape and wine quality,* Melbourne Vic	
K.A. Lattey	Consumer preference — the ultimate quality test		
R.G. Dambergs	Objective measures of grape and wine quality		
I.L. Francis	The chemistry of quality: which grape-derived flavour compounds are key determinants of wine quality?	12 AWITC workshop W61B *Irrigating for quality,* Melbourne Vic	
	Powdery mildew and wine quality — sensory data	12 AWITC workshop W60 *Fungal contaminants — impact on grape and wine quality,* Melbourne Vic	
K.A. Lattey	Characterising sensory properties of red wines: astringency and mouth-feel	12 AWITC workshop W55 *Red wine phenolics,* Melbourne Vic	
A.P. Pollnitz	Stable isotope dilution analysis of aroma and flavour compounds in wine	Staff and students, Deakin University, Geelong Vic	30 Jul 04
P.A. Henschke	Yeast interaction with grape phenolics and effect on wine sensory properties	Lallemand and AWRI research collaboration planning meeting, Urrbrae SA	26 Aug 04
E.J. Bartowsky	Malolactic fermentation		
P.A. Henschke	Potential new fermentation yeast		27 Aug 04
E.J. Bartowsky	Different career opportunities from a degree in science	Science Week talk to Year 6 students, Burnside Primary School, Burnside SA	27 Aug 04
P.W. Godden	The AWRI closure trials	Fine Wine and Spirits trade show, Melbourne Vic	7 Sep 04
G.M. Elsey	Two new potent aroma compounds	SA Water, Bolivar SA	14 Sep 04
G.K. Skouroumounis	The effect of ascorbic acid, closure type and storage conditions on the composition, colour and flavour properties of a Riesling and wooded Chardonnay wine	Winemakers at Orlando Wyndham, Rowland Flat SA	20 Sep 04
	Can we taste the wine without opening the bottle?		
	Interpreting data from different studies — what does it mean for the practitioner?		
I.L. Francis	Wine flavour compounds	AWRI Advanced Wine Assessment Course, Urrbrae, SA	21 Sep 04

Appendix 1. External presentations and talks

Staff	Title of talk	Presented to and where	Date
P.A. Henschke	Use of yeast for shaping wine flavour	Microbiology Laboratories Institute of Medical and Veterinary Science, Adelaide SA	24 Sep 04
R.A. Muhlack	New insights into the adsorption of haze-forming proteins by bentonite during winemaking	Australasian Chemical Engineering Conference, Chemeca 2004 Sustainable Processes, Sydney NSW	29 Sep 04
C.S. Stockley	As we are in South Australia, we will have a light-hearted look at the potential therapeutic value of wine. Is a glass of wine a day beneficial?	Pharmacy Australia Congress 2004, Adelaide SA	17 Oct 04
C.S. Stockley, J.M. Rolland[4], R.E. O'Hehir[4]	Allergen labelling — an Australian case study	IMAG, Canberra ACT	21 Oct 04
C.S. Stockley	An update on the Australian wine industry from a research and regulatory perspective		
M.J. Herderich	Understanding grape and wine tannins	Viticulture 2004 growing our future, Mildura Vic	26 Oct 04
A.D. Coulter	Control and monitoring of *Dekkera/Brettanomyces* during winemaking	Australian Alternative Varieties Wine Show, Mildura Vic	5 Nov 04
A.D. Coulter	Update of the AWRI *Dekkera/Brettanomyces* project: survey and sensory data	Southcorp Technical Winemaking Conference, National Wine Centre, Adelaide SA	11 Nov 04
C.D. Curtin, J.R. Bellon, D.L. Capone, G.D. Cowey, E.M.C. Robinson, M.A. de Barros Lopes[3], P.A. Henschke, P.W. Godden	Update of the AWRI *Dekkera/Brettanomyces* project: genetic and physiological characterisation		
P.W. Godden	Results of the AWRI trial of the technical performance of various wine bottle closures up to 63 months post-bottling, and an examination of factors related to 'reductive' aroma in bottled wine	1st International Screwcap Closure Symposium, Marlborough New Zealand	
C.A. Varela	Microbial modulation of wine sensory characteristics — an overview	Vinos de Chile visit, AWRI, Urrbrae SA	
C.S. Stockley, P.B. Høj[2]	Better wine for better health — fact or fiction?	Australian Academy of Technological Sciences and Engineering, Adelaide SA	15 Nov 04
C.A. Varela	Microbial modulation of wine sensory characteristics — an overview	Errázuriz and Caliterra wineries visit, Urrbrae SA	
E.J. Waters	White wine ageing: the role of ascorbic acid and storage conditions on the composition, colour and flavour properties of a Riesling and wooded Chardonnay wine	Performance BIB, Rowland Flat SA	17 Nov 04
E.J. Waters	White wine ageing: the role of ascorbic acid and storage conditions on the composition, colour and flavour properties of a Riesling and wooded Chardonnay wine	AWRI Roadshow, University of Southern Queensland, Toowoomba Qld	29 Nov 04
P.W. Godden	The ability of various wine bottle closures and fining agents to remove flavour and aroma compounds from wine		
S.-J. Bell	Grape maturity and tannins: the impact of viticultural treatments on grape and wine tannins		
P.A. Henschke	Potential for fermentation yeast and bacteria to modify red wine colour and flavour — results from recent laboratory and pilot scale experiments		
E.J. Waters	Major influences on red wine mouth-feel — the effect of tannins, anthocyanins, ethanol and polysaccharides		
C.D. Curtin, G.A. Ruediger, K.H. Pardon, A.N. Sas[5], P.W. Godden, A.P. Pollnitz	The fate of agrochemical residues during the winemaking process		
I.S. Pretorius	Overview of the AWRI		

[2] Currently at the Australian Research Council
[3] Currently at University of South Australia
[4] Department of Allergy, Immunology and Respiratory Medicine Alfred Hospital/Department of Pathology and Immunology, Monash University
[5] Hardy Wine Company

Staff	Title of talk	Presented to and where	Date
C.D. Curtin, J. Bellon, G.D. Cowey, J.B. Field[1], P. Graves, E.M.C. Robinson, M.A. de Barros Lopes[3], P.A. Henschke, P.W. Godden	The AWRI *Brettanomyces* research trial	AWRI Roadshow, University of Southern Queensland, Toowoomba Qld	29 Nov 04
S.J. Bell	Impact of viticultural practice on grape and red wine colour		
E.J. Waters	The link between bentonite requirements and vineyard and winemaking practices		
P.A. Henschke, M.A. de Barros Lopes[3], J.H. Swiegers, C.A. Varela, K.S. Howell, R. Willmott, A. Hill-Ling, H.E. Smyth, J.R. Bellon, J.M. Eglinton, A.P. Pollnitz, T.E. Siebert, D. Capone, K.A. Lattey, I.L. Francis, E.J. Bartowsky, P.B. Høj[2], I.S. Pretorius	An essential role for yeast in the evolution of varietal flavour		
R.G. Dambergs	Commercial wine quality grading—correlations with spectral properties		
P.W. Godden	Strategies for the control of *Dekkera/ Brettanomyces* during winemaking		
P.W. Godden	Trouble free winemaking — the identification, management and avoidance of common wine instabilities	AWRI roadshow workshops *Managing wine instabilities, identifying wine faults and Quantifying grape colour* and *tannin,* Toowoomba Qld	1, 2 Dec 04
R.G. Dambergs	Red grape colour — what's it all about?		
	Development of a simple tannin assay for wineries		
	Red grape colour practical — part 3		
M.G. Holdstock	Red grape colour practical — part 1		
	Red grape colour practical — part 2		
G.D. Cowey	Use of the AWRI website	AWRI roadshow workshops *Managing wine instabilities, identifying wine faults* and *Quantifying grape colour and tannin,* Toowoomba Qld	1, 2 Dec 04
A.D. Coulter	A tasting of wines with simulated wine faults		
	A *Dekkera/ Brettanomyces* tasting and a diagnostic test for reductive wine characters		
M.A. Daniel	Understanding the formation of damascenone	15th Annual Adelaide Organic Symposium, Flinders University, Bedford Park SA	10 Dec 04
P.W. Godden	Trouble-free winemaking — the identification, management and avoidance of common wine instabilities	AWRI roadshow workshops *Trouble free winemaking: the identification, management and avoidance of wine instabilities*, Griffith, NSW	18, 19, 20 Jan 05
A.D. Coulter	A tasting of wines with simulated faults		
M. Gishen	Laboratory analysis and quality management		
G.D. Cowey	Introduction to AWRI solutions website		
A.D. Coulter, G.D. Cowey, M. Gishen, M.G. Holdstock	Use of a microscope and isolation of hazes/ deposits (theory and practical exercises)		
A.D. Coulter, G.D. Cowey	What bug is that? Identifying common wine microflora (theory and practical demonstration)		
Y. Hayasaka	Chasing mysterious red wine pigments by mass spectrometry	Australian and New Zealand Society for Mass Spectrometry 20th conference, Glenelg SA	1 Feb 05
A.P. Pollnitz, M. Parker, D. Cozzolino, I.L. Francis, M.J. Herderich	A chemometric approach to the analysis of grape aroma by GC-MS: identification of compounds related to the 'pepper' aroma in Australian Shiraz by combining HS-GC-MS with multivariate data analysis	20th Conference of the Australian and New Zealand Society for Mass Spectrometry (ANZSMS20), Glenelg SA	
P.W. Godden	Trouble free winemaking — the identification, management and avoidance of common wine instabilities	AWRI Roadshow workshops *Trouble free winemaking: the identification, management and avoidance of wine instabilities,* Cowra NSW	8, 9 Feb 05

[1] John Field Consulting Pty Ltd
[2] Currently at the Australian Research Council
[3] Currently at University of South Australia

Appendix 1. External presentations and talks

Staff	Title of talk	Presented to and where	Date
M.G. Holdstock	A tasting of wines with simulated faults	AWRI Roadshow workshops *Trouble free winemaking: the identification, management and avoidance of wine instabilities,* Cowra NSW	8, 9 Feb 05
M. Gishen	Laboratory analysis and quality management		
G.D. Cowey	Introduction to AWRI solutions website		
G.D. Cowey, M. Gishen, M.G. Holdstock	Use of a microscope and isolation of hazes/ deposits (theory and practical exercises)		
G.D. Cowey, M.G. Holdstock	What bug is that? Identifying common wine microflora (theory and practical demonstrations)		
H.E. Holt	Leasingham AWRI Clare Cabernet trial — an overview	Clare Valley Grower Day, Clare SA	10 Feb 05
P.A. Smith	Tools for tannin management and their applications in the vineyard		
A.P. Pollnitz, M. Parker, T.E. Siebert	'Black pepper' aroma and flavour in Australian Shiraz	Mount Langi Ghiran and Seppelts, Great Western Vic	10 Mar 05
C.S. Stockley, P.F. Hayes[6]	Evolution of wine regulations in Australia	Vinelink International 2005 Annual General Meeting, Paris France	11 Mar 05
P.W. Godden	Towards offering wine in perfect condition to the consumer — the wine, the closures and the packaging variables: the AWRI (and the Australian and New Zealand wine industry) experience	Enoforum, Piacenza Italy	23 Mar 05
	Strategies for the control of *Dekkera/ Brettanomyces* during winemaking		
E.J. Bartowsky, P.A. Henschke, J.R. Bellon, P.J. Costello, M.A. de Barros Lopes[3], J.M. Eglinton, P.B. Høj[2], K.S. Howell, I.S. Pretorius, A. Soden[7], C.A. Varela	Novel fermentation: are there other ways to achieve unique flavours?	Trier, Germany winemakers and wine consultants mainly from the Mosel region	21 Apr 05
J.M. Eglinton, I.L. Francis, P.A. Henschke	Selection and potential of Australian *Saccharomyces bayanus* yeast for increasing the diversity of red and white wine sensory properties	22nd Lallemand Technical Seminar, Logroño Spain	27–28 Apr 05
P.J. Chambers	The future in a glass	Mount Gambier Innovation Festival, Mount Gambier SA	2 May 05
E.J. Bartowsky, P.A. Henschke	Spoilage of wine by acetic acid bacteria — the story in a bottle	Vinegars and acetic acid bacteria — International Symposium, Reggio Emillia Italy	11 May 05
I.L. Francis	Wine bottle closures — investigations of the performance of natural corks, synthetic closures and screwcaps	International Association of Enology, Management and Wine Marketing, 14th International Enology Symposium, Porto Carras, Chalkidiki Greece	10 May 05
P.W. Godden	Trouble free winemaking — the identification, management and avoidance of common wine instabilities	AWRI roadshow workshops *Trouble free winemaking: the identification, management and avoidance of wine instabilities,* Hunter Valley NSW	10, 11 May 05
A.D. Coulter	A tasting of wines with simulated faults		
M. Gishen	Laboratory analysis and quality management		
M.G. Holdstock	Introduction to AWRI solutions website		
A.D. Coulter, M. Gishen, M.G. Holdstock	Use of a microscope and isolation of hazes/ deposits (theory and practical exercises)		
A.D. Coulter, M.G. Holdstock	What bug is that? Identifying common wine microflora (theory and practical demonstrations)		
M.J. Herderich	Wine research in Australia: cracking the codes of wine flavour	ARIA-SA Association for Research between Italy and Australasia in South Australia, Adelaide SA	24 May 05
S.-J. Bell, P.A. Henschke	The role of MRLs in selling quality wine	Farmer John's Viticulture seminar, Vine Inn, Nuriootpa SA	3 Jun 05
M. Gishen	Defining and measuring grape quality	CRCV Symposium, Mildura Vic	7 Jun 05
P.A. Smith	Development and application of a simple and robust assay for quantitation of tannins in grape and wine samples		

2 Currently at the Australian Research Council
3 Currently at University of South Australia
6 Foster's Wine Estates, Southcorp Wines
7 Foster's Wine Estates, Beringer Blass

Staff	Title of talk	Presented to and where	Date
M.A. Sefton	Wine aroma and flavour — from grapes to glass	CRCV Symposium, Mildura Vic	7 Jun 05
S.-J. Bell	Vineyard nitrogen, yeast nutrition and H_2S prevention	Orlando Winemakers' Vintage Review, Barossa Valley Convention Centre, Tanunda SA	9 Jun 05
P.A. Henschke	Prevention of H_2S — role of yeast nutrition		
S.-J. Bell	Vineyard practices and the impact of colour	Interwinery Analysis Group, Barossa Valley Arts and Convention Centre, Tanunda SA	10 Jun 05
I.S. Pretorius	The AWRI / Development of flavour-active yeasts	AWRI 50th anniversary seminar, Waite Precinct, Urrbrae SA	14 Jun 05
C.S. Stockley	Better wine for better health?		
S.-J. Bell, P.A. Henschke	Nitrogen in grapes and wine		
Y. Hayasaka, G.A. Baldock, A.P. Pollnitz	Application of mass spectrometry to wine science		
P.W. Godden, M. Gishen	Trends in the composition of Australian wine		
M. Gishen, R.G. Dambergs, D. Cozzolino, L.J. Janik, W.U. Cynkar	Grape and wine analysis: chemometrics		
I.L. Francis	Wine flavour		
R.J. Blair	Accessing information from the AWRI		
I.S. Pretorius	The AWRI / Development of flavour-active yeasts	AWRI 50th anniversary seminar, Renmark Hotel, Renmark SA	15 Jun 05
C.S. Stockley	Better wine for better health?		
S.-J. Bell, P.A. Henschke	Nitrogen in grapes and wine		
Y.Hayasaka, G.A. Baldock, A.P. Pollnitz	Application of mass spectrometry to wine science		
P.W. Godden, M. Gishen	Trends in the composition of Australian wine		
M. Gishen, R.G. Dambergs, D. Cozzolino, L.J. Janik, W.U. Cynkar	Grape and wine analysis: chemometrics		
I.L. Francis	Wine flavour		
R.J. Blair	Accessing information from the AWRI		
P.A. Smith	Quantitation of tannins in Australian grape and wine samples: application of a simple and robust tannin assay	American Society of Enology and Viticulture Annual Meeting, Seattle USA	22 Jun 05
R.A. Muhlack	Development of new technologies for the prevention of protein haze formation in white wine		
I.L. Francis	Sensory analysis	Southcorp Wines Winemaker Sensory Panel meeting, Nuriootpa SA	22 Jun 05
E.M.C. Robinson	Towards offering wine in perfect condition to the consumer — the wine, the closures and the packaging variables: the AWRI (and the Australian and New Zealand wine industry) experience	Science of Closures seminar, Seattle USA	24 Jun 05
I.S. Pretorius	The AWRI / Development of flavour-active yeasts	AWRI 50th anniversary seminar, LaTrobe University, Wodonga Vic	28 Jun 05
C.S. Stockley	Better wine for better health?		
S.-J. Bell, P.A. Henschke	Nitrogen in grapes and wine		
E.J. Waters, K.F. Pocock	Preventing protein haze in bottled white wine		
P.W. Godden, M. Gishen, A.D. Coulter	Trends in the composition of Australian wine		
M.J. Herderich	Analysis of grape and wine tannins		
P.J. Chambers	The genetics of olfaction and taste		
R.J. Blair	Accessing information from the AWRI		
I.S. Pretorius	The AWRI / Development of flavour-active yeasts	AWRI 50th anniversary seminar, Bendigo Regional Institute of TAFE, Bendigo Vic	29 Jun 05
C.S. Stockley	Better wine for better health?		
S.-J. Bell, P.A. Henschke	Nitrogen in grapes and wine		
E.J. Waters, K.F. Pocock	Preventing protein haze in bottled white wine		
P.W. Godden, M. Gishen, A.D. Coulter	Trends in the composition of Australian wine		
M.J. Herderich	Analysis of grape and wine tannins		

Appendix 1. External presentations and talks

Staff	Title of talk	Presented to and where	Date
P.J. Chambers	The genetics of olfaction and taste	AWRI 50th anniversary seminar, Bendigo Regional Institute of TAFE, Bendigo Vic	29 Jun 05
R.J. Blair	Accessing information from the AWRI		
C.D. Curtin	Microbes and wine aroma	Postgraduate students, School of Medicine, Flinders University, Bedford Park SA	
I.S. Pretorius	The AWRI / Development of flavour-active yeasts	AWRI 50th anniversary seminar, Crown Hotel, Melbourne Vic	30 Jun 05
C.S. Stockley	Better wine for better health?		
S.-J. Bell, P.A. Henschke	Nitrogen in grapes and wine		
E.J. Waters, K.F. Pocock	Preventing protein haze in bottled white wine		
P.W. Godden, M. Gishen, A.D. Coulter	Trends in the composition of Australian wine		
M.J. Herderich	Analysis of grape and wine tannins		
P.J. Chambers	The genetics of olfaction and taste		
R.J. Blair	Accessing information from the AWRI		

Workshops

Conducted by	Title of workshop	Held	Date
D. Cozzolino	W04 Hands on in chemometrics	12 AWITC, Melbourne Vic	24 Jul 04
M.J. Herderich	W05, W25, W55 From grape to glass: viticultural and winemaking impacts on red wine phenolics		24, 26, 29 Jul 04
J.M. Eglinton	WO6, W26, W56 Winemaking with non-conventional yeast		24, 26 and 29 Jul 04
P.W. Godden, M. Gishen, A.D. Coulter, E.M.C. Robinson, G.D. Cowey	W07, W27, W47 *Brettanomyces* — latest research and control strategies		24, 26, 28 Jul 04
M. Gishen, D. Georg[37]	W08 Intergrated management systems (food safety [HACCP]/ OH&S/ environment) for wine grapegrowers		24 Jul 04
D. Cozzolino	W14 Introduction to IR Spectroscopy		25 Jul 04
S.-J. Bell	W17 Salinity in the vineyard and in wine		25 Jul 04
M.A. Sefton	W19 Latest advances in cork processing technology		
E.J. Bartowsky	W15, W66 Malolactic fermentation		25, 29 Jul 04
M. Gishen	W28 Quality management – introduction to HACCP		26 Jul 04
M. Gishen, W. Davidson[38]	W38 Quality management and food safety options for wineries		27 Jul 05
D. Cozzolino	W34 Applications of IR spectroscopy: from laboratory to industry		27 Jul 05
I.L. Francis, L. Norris[8]	W46 Wine flavour		28 July 04
M. Gishen, G. Ainio[39]	W45 Quality management – HACCP plan development (advanced)		28 Jul 04
M.G. Holdstock	W49 Colour measurement of red grapes — how to get started		28 Jul 05
C.S. Stockley	W58 Medically, is wine just another alcoholic beverage? Results from the GWRDC-funded wine and health research projects		29 Jul 04
M. Gishen, R.G. Dambergs	W71 Objective measures of grape and wine quality		29 Jul 04
D. Cozzolino, R.G. Dambergs, W.U. Cynkar, L. Janik, M. Gishen	Introduction to multivariate analysis	Yalumba Wines — pilot trial workshop for winemakers and viticulturists	28 Sept 04

8 FlavorSense, USA
37 Smith and Georg Pty. Ltd.
38 Wendy Davidson Enterprises
39 Ainio and Associates

Conducted by	Title of workshop	Held	Date
P.W. Godden, R.G. Dambergs, A.D. Coulter, G.D. Cowey, M.G. Holdstock	Managing wine instabilities, identifying wine faults	AWRI roadshow workshops, Toowoomba Qld	1 and 2 Dec 04
	Quantifying grape colour and tannin		
P.W. Godden, M. Gishen, A.D. Coulter, G.D. Cowey, M.G. Holdstock	Trouble free winemaking: the identification, management and avoidance of wine instabilities	AWRI roadshow workshops, Griffith, NSW	18, 19, 20 Jan 05
		AWRI roadshow workshops, Cowra NSW	8, 9 Feb 05
		AWRI roadshow workshops *Trouble free winemaking: the identification, management and avoidance of wine instabilities,* Hunter Valley NSW	10, 11 May 05

Posters

Author(s)	Title of poster	Presented at	Date
G.A. Baldock, Y. Hayasaka	Screening method for petroleum-derived aromatic hydrocarbons in wine	12 AWITC, Melbourne Vic	24–28 Jul 04
G.A. Baldock, D. Boehm, P.W. Godden, Y. Hayasaka	Use of mass spectrometry to investigate brine contamination of wine		
E.J. Bartowsky, G.R. Linton[9], P.A. Henschke	Acetic acid bacteria and red wine spoilage of bottled red wine		
E.J. Bartowsky, J.M. McCarthy, T.E. Siebert, A.P. Pollnitz, K.A. Lattey, I.L. Francis, P.A. Henschke	Malolactic fermentation: effect of strain on wine chemical composition and sensory properties		
J.R. Bellon, C. Curtin, G.D. Cowey, J.B. Field[1], P. Graves, E.M. Robinson, P.B. Høj[2], P.W. Godden, P.A. Henschke, M.A. de Barros Lopes[3]	Distribution of genetically diverse Australian *Dekkera/ Brettanomyces* isolates		
J.R. Bellon, T.E. Siebert, A.P. Pollnitz, L. Rose[9], M.A. de Barros Lopes[3]	Flavour and aroma diversity of wine using interspecific hybrids of *Saccharomyces* yeast		
S.-J. Bell	Impact of season and viticultural practice on red grape phenolics		
M. Birse, A.P. Pollnitz, M.J. Kwiatkowski, H. Gockowiak, M. Parker, J.M. Eglinton, M.J. Herderich	Anthocyanins, anthocyanin-derived pigments and the colour of red wine		
M. Birse, A.P. Pollnitz, M.J. Herderich	CIELab colour values: enhanced wine colour measurement for use by the wine industry and in research applications		
D.R. Boehm, G.A. Ruediger	Histamine in wines		
R.C. Brown, G.M. Elsey, D.K. Taylor[10]	Towards the synthesis of optically pure oak lactones		
S.L. Brown[11], K.F. Pocock, M.A. de Barros Lopes[3], P.B. Høj[2], E.J. Waters	Reducing haziness in white wine by overexpression of *Saccahromyces cerevisiae* mannoproteins		
A. Cox, G.M. Elsey, M.V. Perkins[12], M.A. Sefton	TPB — a potent grape-derived odorant in wine		
D. Cozzolino, H.E. Smyth, K.A. Lattey, W.U. Cynkar, I.L. Francis, R.G. Dambergs, M. Gishen	A preliminary investigation of the potential of near infrared spectroscopy to predict sensory properties in white wines		

[1] John Field Consulting Pty Ltd
[2] Currently at the Australian Research Council
[3] Currently at University of South Australia
[5] Hardy Wine Company
[9] S. Smith & Son, Yalumba Wines
[10] University of Adelaide, Department of Chemistry
[11] Currently at GeneWorks Pty. Ltd.
[12] Flinders University

Appendix 1. External presentations and talks

Author(s)	Title of poster	Presented at	Date
D. Cozzolino, L. Janik, C. Bevin[5], A. Lim[5], W.U. Cynkar, R.G. Dambergs, M. Gishen	Calibration of a fast diode array spectrophotometer for the measurement of red grape composition: total anthocyanins, total soluble solids and pH	12 AWITC, Melbourne Vic	24–28 Jul 04
D. Cozzolino, W.U. Cynkar, L. Janik, R.G. Dambergs, I.L. Francis, M. Gishen	Effect of freezing and frozen sample storage on visible and near infrared calibration for determination of total anthocyanins in red grapes		
D. Cozzolino, W.U. Cynkar, L. Janik, R.G. Dambergs, I.L. Francis, M. Gishen	Measurement of colour, total soluble solids and pH in whole red grapes using visible and near infrared spectroscopy		
D. Cozzolino, S. Dillon[9], E.J. Bartowsky, P.A. Henschke, W.U. Cynkar, L. Janik, R.G. Dambergs, M. Gishen	Monitoring fermentation of red wine using near infrared spectroscopy		
D. Cozzolino, W.U. Cynkar, L. Janik, R.G. Dambergs, I.L Francis, M. Gishen	Prediction of total anthocyanins in individual grape berries using visible and near infrared spectroscopy		
D. Cozzolino, M.J. Kwiatkowski, G.K. Skouroumounis, E.J. Waters, W.U. Cynkar, R.G. Dambergs, L. Janik, M. Gishen	Preliminary study on the use of near infrared spectroscopy to assess wine composition in a bottle		
D. Cozzolino, M.J. Kwiatkowski, M. Parker, R.G. Dambergs, W.U. Cynkar, M. Gishen, M.J. Herderich	Quantitative analysis of phenolic compounds in red wine fermentation using near infrared spectroscopy		
D. Cozzolino, M.J. Kwiatkowski, G.K. Skouroumounis, E.J. Waters, W.U. Cynkar, R.G. Dambergs, L. Janik, M. Gishen	The use of visible and near infrared spectroscopy to measure the relative degree of oxidation in white wine		
D. Cozzolino, H.E. Smyth, K.A. Lattey, W.U. Cynkar, I.L. Francis, R.G. Dambergs, M. Gishen	White wine varietal discrimination using near infrared reflectance spectroscopy		
C.D. Curtin, J.R. Bellon, G.D. Cowey, M.A. de Barros Lopes[3], J.B. Field[1], E.M.C. Robinson, P.A. Henschke, P.W. Godden	Physiochemical characterisation of *Dekkera/ Brettanomyces* yeast isolated from Australian red wines		
W.U. Cynkar, D. Cozzolino, R.G. Dambergs, L. Janik, I.L. Francis, M. Gishen	Effect of sample preparation and storage on the determination of quality parameters in red grape berries of *Vitis vinifera*		
W.U. Cynkar, D. Cozzolino, L. Janik, R.G. Dambergs, I.L. Francis, M. Gishen	Prediction of glycosylated compounds in Chardonnay and Riesling grape juice by near infrared and mid-infrared spectroscopy		
R.G. Dambergs, A. Kambouris[13], W.U. Cynkar, L.J. Janik, D. Cozzolino, P.A. Henschke, M. Gishen	A comparison of near infrared and mid-infrared spectroscopy for the analysis of yeast assimilable nitrogen in grape juice		
R.G. Dambergs, D. Cozzolino, W.U. Cynkar, L. Janik, I.L. Francis, M. Gishen	An examination of the effects of vintage, region and variety on analysis of wine grape quality parameters by near infrared spectroscopy		
R.G. Dambergs, B. Stummer[14], T. Zanker[14], D. Cozzolino, M. Gishen, E. Scott[14]	Near infrared spectroscopy as a tool for detection of powdery mildew in homogenised grapes		

[1] John Field Consulting Pty Ltd
[3] Currently at University of South Australia
[5] Hardy Wine Company
[9] S. Smith & Son, Yalumba Wines
[13] McGuigan Simeon Wines
[14] The University of Adelaide, School of Agriculture and Wine

Author(s)	Title of poster	Presented at	Date
C.G. Daniel, M.E. Francis, I.B.M. Oats, R.J. Blair	Technical information services from The Australian Wine Research Institute	12 AWITC, Melbourne Vic	24–28 Jul 04
	Technical publications from The Australian Wine Research Institute		
	Electronic information from The Australian Wine Research Institute		
M.A. Daniel, G.M. Elsey, M.A. Sefton	Consumption of damascenone in wine by SO_2		
S.J. Dillon[9], E.J. Bartowsky, K.A. Lattey, I.L. Francis, A. Ortiz-Julien[15], A.J. Markides[16], P.A. Henschke	Effect of yeast on the colour, phenolic and sensory properties of a Shiraz wine		
J.M. Eglinton, T.E. Siebert, I.L. Francis, P.A. Henschke	Compositional and sensory implications of practical strategies for ensuring complete fermentation with a non-conventional yeast		
J.M. Eglinton, M. Grießer[17], P.A. Henschke, M.J. Herderich	Yeast-mediated formation of pigmented polymers in model red wine ferments		
M. Fettke[18], P.J. Costello[16], E.J. Bartowsky, P.A. Henschke	Wine yeast and malolactic bacteria compatibility: role of amino acids and yeast lees		
T. Girbau[19], B.E. Stummer[14], K.F. Pocock, G.A. Baldock, E.S. Scott[14], E.J. Waters	Powdery mildew and *Botrytis cinerea* infection of grapes causes changes in content of haze-forming proteins in juice and wine		
A. Grimaldi[14], E.J. Bartowsky, V. Jiranek[14]	Characterisation of glycosidase enzymes of wine lactic acid bacterium, *Oenococcus oeni*		
Y. Hayasaka, G.K. Skouroumounis, S. Vidal[20]	Compositional investigation of skin tannin: mass spectrometric evidence for the existence of oligomeric anthocyanins		
Y. Hayasaka, J.A. Kennedy[21]	Compositional investigation of wine tannin: mass spectrometric evidence for the presence of pigmented polymer		
Y. Hayasaka, M. Birse, J.M. Eglinton, M.J. Herderich	Yeast and red wine colour: impact beyond fermentation		
K.S. Howell, J.H. Swiegers, R. Willmott, G.M. Elsey, T.E. Siebert, D.L. Capone, M.A. Sefton, E.J. Bartowsky, G.H. Fleet[22], P.B. Høj[2], I.S. Pretorius, M.A. de Barros Lopes[3]	Variable release of volatile thiols by wine yeast and its impact on varietal character		
L. Janik, W.U. Cynkar, D. Cozzolino, M. Gishen, R.G. Dambergs	The potential of attenuated total reflectance mid-infrared spectroscopy for grape compositional analysis		
P.R. Jones, I.L. Francis, E.J. Waters	Interactions between non-volatile and volatile wine components on the sensory properties of wine — preparation of a reconstituted wine-like model wine		
M.J. Kwiatkowski, G.K. Skouroumounis, D. Cozzolino, I.L. Francis, K.A. Lattey, A. Kleinig[6,23], E.J. Waters	Impact of ullage volume under screw cap (ROTE) on chemical composition and sensory properties of a Cabernet Sauvignon wine		

2 Currently at the Australian Research Council
3 Currently at University of South Australia
6 Foster's Wine Estate, Southcorp Wines
9 S. Smith & Son, Yalumba Wines
14 The University of Adelaide, School of Agriculture and Wine
15 Lallemand S.A., France
16 Lallemand Australia
17 Biomolekulare Lebensmitteltechnologie, Technische Universität, Germany
18 Currently at C.A. Henschke & Co
19 Nutricio i Bromatologia, Centre de Referencia en Tecnologia dels Aliments (CeRTA), Facultat de Farmacia, Universitat de Barcelona, Spain
20 Inter-Rhone, Institut Rhodanien, France
21 Oregon State University, USA
22 Food Science and Technology, School of Chemical Sciences, The University of New South Wales
23 Currently at Tarac Technologies

Appendix 1. External presentations and talks

Author(s)	Title of poster	Presented at	Date
K.A. Lattey, H.E. Smyth, N.E. D'Costa, B.K. Liebich[24], I.L. Francis	Consumer acceptability and sensory properties of a set of commercial Australian Riesling and unwooded Chardonnay wines	12 AWITC, Melbourne Vic	24–28 Jul 04
F.K. Lloyd[25], B.K O'Neill[25], E.J. Waters, A. Lim[5], C.B. Colby[25]	Combined heat/enzyme treatment for prevention of protein haze in wine		
L. Low[25], B.K. O'Neill[25], C. Ford[14], J. Godden[26], M. Gishen, C.B. Colby[25]	Evaluating alternative tartrate stabilisation methods for wine		
C. Martabit[27], C.A. Varela, J. Saintz[27], E. Agosin[27]	A model combining sugar uptake kinetics and metabolic networks for predicting wine fermentations		
R.A. Muhlack[25], E.J. Waters, B.K. O'Neill[25], A. Lim[5], C.B. Colby[25]	New insights into the adsorption of haze-forming proteins by bentonite during winemaking		
M. Parker, P.A. Smith, M. Birse, M.J. Kwiatkowski, H. Gockowiak, K.A. Lattey, B.K. Liebich[24], I.L. Francis, M.J. Herderich	The effects on red wine of pre- and post-ferment additions of grape-derived tannin		
J.L. Rogers[25], C.B. Colby[25], M. Gishen, S. Clarke[14], B.K. O'Neill[25]	Automated software for dynamic optimization of winery production scheduling		
T. Scherer[28], F. Peacock[28], S. Stanley[28], R. Walker[29], B. Leditschke[29], M. Gishen, D. Cozzolino	Tasmanian pinot noir vineyard monitoring project		
T.E. Siebert, H.E. Smyth, M.J. Herderich, M.A. Sefton, A.P. Pollnitz	Quantification of 31 important fermentation-derived compounds in wine		
R.F. Simpson, D. Capone, B. Duncan[30], M.A. Sefton	Identification of a new cork taint compound		
G.K. Skouroumounis, M.J. Kwiatkowski, M.A. Sefton, E.J. Waters, R.G. Dambergs	The use of chemometrics to select optimum wavelengths for the spectrophotometric determination of browning in white wines		
G.K. Skouroumounis, M.J. Kwiatkowski, I.L. Francis, R.G. Dambergs, H. Oakey[31], D.L. Capone, A. Kleinig[6,23], D. Cozzolino, B. Duncan[30], M.A. Sefton, E.J. Waters	The effect of ascorbic acid, closure type and storage conditions on the composition , colour and flavour properties of a Riesling and wooded Chardonnay wine		
C.S. Stockley, K. Stimson[32], I. Glaspole[4], E. Apostolou[4], J.M. Rolland[4], R.E. O'Hehir[4]	Double-blind placebo-controlled clinical trial of fined wines in subjects with confirmed sensitivity to eggs, fish, milk or nuts		
C.S. Stockley, E. Apostolou[4], I. Glaspole[4], K. Stimson[4], R.E. O'Hehir[4], J.M. Rolland[4]	An investigation of potential residual allergenic fining proteins in wine		
R.L. Taylor, G.A. Ruediger	Determining the impact of pesticide residues on the winemaking process		
	Development of 2,4,6 trichloroanisole (TCA) analysis in wine using solid phase microextraction (SPME)		

4 Department of Allergy, Immunology and Respiratory Medicine Alfred Hospital/Department of Pathology and Immunology, Monash University
5 Hardy Wine Company
6 Foster's Wine Estate, Southcorp Wines
14 The University of Adelaide, School of Agriculture and Wine
24 Provisor Pty Ltd
25 The University of Adelaide, School of Chemical Engineering
26 Berri Estates Winery
27 Departamento Ingeniería Química y Bioprocesos, Pontificia Universidad Católica de Chile, Santiago Chile
28 Vineyards Association of Tasmania Technical Committee
29 Serv-Ag
30 Symphony Hill Wines
31 Biometrics SA
32 Department of Allergy, Immunology and Respiratory Medicine, Alfred Hospital

Author(s)	Title of poster	Presented at	Date
D. Torrea, T.E. Siebert, B. Liebich[24], C. Ancin[33], I.L. Francis, P.A. Henschke	Effect of ammonium supplementation of a Chardonnay must on wine aroma	12 AWITC, Melbourne Vic	24–28 Jul 04
C.A. Varela, J. Cárdenas[27], E. Agosin[27]	Gene expression profiles and metabolic fluxes during wine fermentation		
S. Vidal[20], I.L. Francis, M.J. Kwiatkowski, V. Cheynier[34], E.J. Waters	The likely taste and mouth-feel role of some wine tannin-like compounds and simple wine pigments		
M. Walker[5], A. Vystavelova[5], S. Pedler[26], J.M. Eglinton, V. Jiranek[14]	Towards tools for 'seamless' modification of genes in industrial yeast		
K.L. Wilkinson, G.M. Elsey, R.H. Prager[35], A.P. Pollnitz, M.A. Sefton	Why does oak intensity sometimes increase after removal of the wood?		
G.A. Baldock, Y. Hayasaka	Screening method for petroleum-derived aromatic hydrocarbons in wine	Australian and New Zealand Society for Mass Spectrometry 20th Conference, Glenelg SA	30 Jan–3 Feb 05
T.E. Siebert, H.E. Smyth, M.J. Herderich, M.A. Sefton, A.P. Pollnitz	Quantification of 31 important fermentation-derived compounds in wine		
C.G. Daniel, R.J. Blair	Environmental health and management information available from The Australian Wine Research Institute	Wine and Environment Conference, Adelaide SA	2–3 Feb 05
M.J. Kwiatkowski, D. Cozzolino, G. Skouroumounis, A. Kleinig[6,23], M. Gishen, E.J. Waters	The use of visible and near infrared spectroscopy to predict colour, composition and sensory parameters of red and white wines	12th International Conference on Near Infrared Spectroscopy, Auckland New Zealand	10–15 Apr 05
J.H. Swiegers, R. Willmott, A. Hill-Ling, D.L. Capone, K.H. Pardon, G.M. Elsey, K.S. Howell, M.A. de Barros Lopes[3], M.A. Sefton, M. Lilly[36], I.S. Pretorius	Modulation of volatile thiol and ester aromas by modified wine yeast	Weurman Flavour Research Symposium, Roskilde Denmark	21–24 Jun 05
M.A. Daniel, G.M. Elsey, M.V. Perkins[35], M.A. Sefton	The consumption of damascenone during early wine maturation		

3 Currently at University of South Australia
5 Hardy Wine Company
6 Foster's Wine Estate, Southcorp Wines
14 The University of Adelaide, School of Agriculture and Wine
20 Inter-Rhone, Institut Rhodanien, France
23 Currently at Tarac Technologies
24 Provisor Pty Ltd
26 Berri Estates Winery
27 Departamento Ingeniería Química y Bioprocesos, Pontificia Universidad Católica de Chile, Santiago Chile
33 Department of Applied Chemistry, Universidad Publica de Navarra, Pamplona (Navarra), Spain
34 Unité Mixte de Recherche Sciences pour l'Oenologie, INRA, Montpellier France
35 Flinders University
36 Institute for Wine Biotechnology Stellenbosch University, Stellenbosch South Africa

Other activities

Staff	Activity	Date
P.W. Godden, M. Gishen, K.A. Lattey, G.D. Cowey, A.D. Coulter, M.G. Holdstock, N.E. D'Costa, B. Liebich[24], C. Cynkar	Advanced Wine Assessment Course, Adelaide, SA	21–24 Sep 04
P.W. Godden	Associate judge, Royal Adelaide Wine Show	27–30 Sep 04

24 Provisor Pty Ltd

Appendix 2. Teaching responsibilities of AWRI staff during 2004/05

Subject	No. of lectures	AWRI staff
2004 — Semester 2		
The University of Adelaide		
3045WT/7048WT Advances in Oenology	4 3 2	P.A. Henschke E.J. Bartowsky I.L. Francis
9685 Advances in Oenology	4	M.J. Herderich
3003WT and Advances in Oenology	1	P.W. Godden
1958 Wine packaging and quality management	1	M. Gishen
7004WT Wine Packaging and Quality Management	1	P.W. Godden
The Flinders University of South Australia		
MMED 3921 Industrial and Pharmaceutical Microbiology	Double	P.A. Henschke
BTEC 9671 Bioprocessing and Industrial Biotechnology		
2005 — Semester 1		
The University of Adelaide		
2001WT and 7030WT Wine and Society	2	C.S. Stockley
3005WT Grape Industry Practice Policy and Communication	50	C.S. Stockley
3007WT Stabilisation and clarification	3 1	E.J. Waters A.D. Coulter
3009WT Advanced Sensory Practice	8	P.W. Godden
3011WT/3011WA/7013WT Winemaking	2	P.A. Henschke
3002WT Biotechnology in the food and wine industries	2	P.J. Chambers
Flinders University of SA		
CPES7001 Aromaticity and Pericyclic Reactions (Honours course)	12	G.M. Elsey

Appendix 3. Graduate and Honours student supervision responsibilities of AWRI staff for 2004/05

Student	Supervisor/s	Source of funds
PhD		
A. Bandara	G. Stanley[1], S. Fraser[1], P.J. Chambers	Victoria University (Melbourne)
M. Birse	M.J. Herderich, I.L. Francis, A. Pollnitz	GWRDC/CRCV
R.C. Brown	G.M. Elsey, M.A. Sefton, M.V. Perkins[2]	GWRDC/CPGS
A. Cox	G.M. Elsey, M.A. Sefton, M.V. Perkins[2]	CRCV
M.A. Daniel	G.M. Elsey, M.A. Sefton, M.V. Perkins[2]	CRCV
E. Dennis	P.J. Smith, M.V. Perkins[2]	GWRDC, Flinders University
D. Kutyna	P.J. Chambers, P.A. Henschke, C.A. Varela, G.Stanley[1]	GWRDC
F. Lloyd	E.J. Waters, C.B.Colby[3], B.K. O'Neill[3], A. Lim[4]	School of Chemical Engineering, University of Adelaide/GWRDC
A. Grimaldi	E.J. Bartowsky, V. Jiranek[5]	GWRDC/University of Adelaide
L. Low	B.K. O'Neill[3], D. Lewis[3], C. Ford[5], J. Godden[3], M. Gishen and C. Colby[3]	GWRDC/Adelaide University
0.J. McIntyre	E.J. Waters, I.S. Pretorius, C.B. Colby[3], B. O'Neill[3], A. Lim[4]	School of Chemical Engineering, University of Adelaide/GWRDC
I. Mohammed	G. Stanley[1], P.J. Chambers	ARC
R.A. Muhlack	E.J. Waters, P.B. Høj, C.B.Colby[3], B.K. O'Neill[3], A. Lim[4]	School of Chemical Engineering, University of Adelaide/GWRDC/ The Hardy Wine Company

[1] Victoria University, School of Molecular Sciences
[2] Flinders University, School of Chemistry, Physics and Earth Sciences
[3] The University of Adelaide, School of Chemical Engineering
[4] Hardy Wine Company
[5] The University of Adelaide, School of Agriculture and Wine

Student	Supervisor/s	Source of funds
PhD		
C. Payne	S. Bastian[5], M.J. Herderich	University of Adelaide
C.J. Puglisi	G.M. Elsey, M.A. Sefton, R.H. Prager[2]	GWRDC/CRCV
R. Ristic	P.J. Iland[6], I.L. Francis, M.J. Herderich	GWRDC
J. Rogers	C.B. Colby[3], M. Gishen, S.J. Clarke[5], B.K. O'Neill[3]	GWRDC/Adelaide University
H.E. Smyth	I.L. Francis, M.A. Sefton, M.J. Herderich	GWRDC
D. Stanley	G. Stanley[1], S. Fraser[1], P.J. Chambers	Victoria University (Melbourne)
T. Tran	P.J. Chambers, G. Stanley[1], M.A. de Barros Lopes[7]	Victoria University (Melbourne) and AWRI
K. L. Wilkinson	G.M. Elsey, M.A. Sefton, R.H. Prager[2]	GWRDC
Honours		
E. Dennis	P.J. Smith, M.V. Perkins[2]	GWRDC, Flinders University
C. Sarneckis	P.J. Smith, P.R. Jones	GWRDC, Flinders University
G. Alexander	P.R. Jones, E.J. Waters	School of Agriculture and Wine, University of Adelaide/GWRDC
S. Henderson	P.J. Chambers, E.J. Waters	Flinders University/GWRDC
M.H. Turner	G.M. Elsey	SoCPES-Flinders University
L-H. Ly	G.M. Elsey	SoCPES-Flinders University
R. Moore	G.M. Elsey	SoCPES-Flinders University
N. Cain	G.M. Elsey	SoCPES-Flinders University

[1] Victoria University, School of Molecular Sciences
[2] Flinders University, School of Chemistry, Physics and Earth Sciences
[3] The University of Adelaide, School of Chemical Engineering
[5] The University of Adelaide, School of Agriculture and Wine
[6] Patrick Iland Wine Promotions
[7] University of South Australia

Theses completed

Student	Hon/PhD	Title of thesis	Supervisors
A. Cox	PhD	TPB: A new, potent, grape-derived aroma compound in wine	G.M. Elsey, M.A. Sefton, M.V. Perkins[2]
K.S. Howell	PhD	The contribution of *Saccharomyces* yeasts to aroma formation during wine fermentation	M.A. de Barros Lopes[7], G.H. Fleet[8], E.J. Bartowsky, P.A. Henschke
R. Ristic	PhD	A study of seed development and phenolic compounds in seeds, skins and wines of *Vitis vinifera* L. cv. Shiraz	P.J. Iland[6], I.L. Francis, M.J. Herderich
H.E. Smyth	PhD	The compositional basis of the aroma of Riesling and unwooded Chardonnay wine	I.L. Francis, M.A. Sefton, M.J. Herderich
M. Ugliano	PhD	The contribution of fermentation processes and winemaking technologies on the expression of wine varietal aroma	L. Moio[9], P.A. Henschke, E.J. Bartowsky
K.L. Wilkinson	PhD	Oak derived flavour compounds and their contribution to wine and spirits	G.M. Elsey, M.A. Sefton, R.H. Prager[2]
G. Alexander	Hon	The elucidation of non-proteinaceous key factors absolutely required for visible protein haze formation in white wine	P.R. Jones, E.J. Waters
V. Bouyer	Hon	Impact of glycosidases on wine aromatic compounds during fermentations	E.J. Bartowsky
E. Dennis	Hon	Synthesis and characterization of A-type tannins	P.J. Smith, M.V. Perkins[2]
L-H. Ly	Hon	Towards the synthesis and sensory analysis of enantiomerically pure 3-MH, an important aroma compound in wine	G.M. Elsey
C. Sarneckis	Hon	Development of an assay to quantify tannins in grape and wine samples	P.J. Smith, P.R. Jones
M.H. Turner	Hon	Investigation of the potential scavenging effect of catechin on volatile oak flavour compounds	G.M. Elsey

[2] Flinders University, School of Chemistry, Physics and Earth Sciences
[6] Patrick Iland Wine Promotions
[7] University of South Australia
[8] Food Science and Technology, School of Chemical Sciences, The University of New South Wales
[9] Universitá di Foggia

Appendix 4 – AWRI Staff Publications 2004/05

775 a Ruediger, G.A.; Pardon, K.H.; Godden, P.W.; Pollnitz, A.P. Removal of pesticides from red and white wine by the use of fining and filter agents. *Aust. J. Grape Wine Res.* 10: 8–16; 2004.

776 Bartowsky, E.J.; Costello, P.J.; Villa, A.; Henschke, P.A. The chemical and sensorial effects of lysozyme addition to red and white wines over six months' cellar storage. *Aust. J. Grape Wine Res.* 10: 143–150; 2004.

777 Girbau, T.; Stummer, B.E.; Pocock, K.F.; Baldock, G.A.; Scott, E.S.; Waters, E.J. The effect of *Uncinula necator* (powdery mildew) and *Botrytis cinerea* infection of grapes on the levels of haze-forming pathogenesis-related proteins in grape juice and wine. *Aust. J. Grape Wine Res.* 10: 125–133; 2004.

778 Bartowsky, E.J.; Henschke, P.A. Acetic acid bacteria and wine: all is well until oxygen enters the scene. *Aust. N.Z. Grapegrower Winemaker* (485a): 86–91; 2004.

779 Stockley, C.S. Can histamine in wine cause adverse reactions for consumers? *Aust. N.Z. Grapegrower Winemaker* (485a): 77, 79–82; 2004.

780 Wilkinson, K.L.; Elsey, G.M.; Prager, R.H.; Pollnitz, A.P.; Sefton, M.A. Rates of formation of *cis*- and *trans*- oak lactone from 3-methyl-4-hydroxyoctanoic acid. *J. Agric. Food Chem.* 52: 4213–4218; 2004.

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785 Blair, R. Australian wine benefits from international flavour. *Aust. N.Z. Wine Ind. J.* 19(3): 47–49; 2004.

786 Stockley, C. Moderation in Australia — policy and achievements. *Biol. Res.* 37: 201–207; 2004.

787 Bartowsky, E.J.; Dillon, S.J.; Ortiz-Julien, A.; Markides, A.J.; Henschke, P.A. Yeast choice links reds to depth of colour *Aust. Vig.* 4(3): 52–54; 2004.

788 Capone, D.; Sefton, M.; Pretorius, I.; Høj, P. Flavor 'scalping' by wine bottle closures. 'Winemaking' continues after bottling. *Pract. Winery Vineyard* 26(2): 44, 47–48, 50, 52–55; 2004.

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790 Wilkinson, K.L.; Elsey, G.M.; Prager, R.H.; Tanaka, T.; Sefton, M.A. Precursors to oak lactone. Part 2: Synthesis, separation and cleavage of several -D-glucopyranosides of 3-methyl-4-hydroxyoctanoic acid. *Tetrahedron* 60: 6091–6100; 2004.

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795 Bartowsky, E.J.; Henschke, P.A. The 'buttery' attribute of wine — diacetyl — desirability, spoilage and beyond. *Int. J. Food Micro.* 96: 235–252; 2004.

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797 Cozzolino, D.; Esler, M.B.; Dambergs, R.G.; Cynkar, W.U.; Boehm, D.R.; Francis, I.L.; Gishen, M. Prediction of colour and pH in grapes using a diode array spectrophotometer (400–1100 nm) *J. Near Infrared Spectrosc.* 12: 105–111; 2004.

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800 Francis, L. Sealing and storing bottled wine: assessing the sensory properties of wines stored under corks, screw-caps and plastic stoppers. *What's New Food: Technol. Manufact.* 12(3): 110–111; 2004.

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810 Pretorius, I.S.; de Barros Lopes, M.A.; Høj, P.B. Development of superior wine yeast: current status and future opportunities to meet the consumer challenge. *Bull. OIV* 77: 389–421; 2004.

811 Howell, K.S.; Swiegers, J.H.; Elsey, G.M.; Siebert, T.E.; Bartowsky, E.J.; Fleet, G.H.; Pretorius, I.S.; de Barros Lopes, M.A. Variation in 4-mercapto-4-methyl-pentan-2-one release by *Saccharomyces cerevisiae* commercial wine strains. *FEMS Microbiol. Lett.* 240: 125–129; 2004.

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Appendix 5 – Media interviews

Date	Staff member	Discussed	Media
13 Jul 04	I.S. Pretorius	GM wine yeasts and vines	Ben van Raaij, Science Editor, *De Volkskrant* (The Netherlands)
8 Jul 04	P.W. Godden	Closures, wine ageing, *Brett* and tannins/phenolics	Jamie Goode, Freelance, *Harpers* and Mitchell Beazley (United Kingdom)
9 Jul 04	P.W. Godden	Information on article about closures. Incidence of TCA taint	Nick Stock *Adelaide Review*
15 Jul 04	P.W. Godden	Closures a consumer perspective	Chris Snow, Freelance
20 Jul 04	P.W. Godden	CO_2 in wine	Sally Easton, *Harpers* (United Kingdom)
21 Jul 04	P.W. Godden	How long does wine last when opened, and best storage methods	Joanna Hall, *Sunday Telegraph*
21 Jul 04	P.W. Godden	Closures particularly screwcap uptake	Helen Matterson, *The Weekend Australian*
4 Aug 04	P.W. Godden	Update on AWRI closure trials	Chris Snow, *Herald Sun*
7 Sep 04	P.W. Godden	Various AWRI research trials, particularly closures and *Brettanomyces*	Jamie Goode, Freelance, *Harpers* and Mitchell Beazley (United Kingdom)
7 Sep 04	P.W. Godden	AWRI closure trial	Robert Joseph, *Wine* (United Kingdom)
7 Sep 04	M. Gishen and P.J. Smith	Wine quality, style, and compositional analysis	Jaimie Goode, *Wine Anorak* (United Kingdom)
7 Oct 04	P.W. Godden	Closures	Jeff Strong, *The Age*
26-Oct-04	P.W. Godden and K.A. Lattey	Wine 'ageing' devices	Max Allen *The Weekend Australian*
3 Nov 04	P.W. Godden	Closures	Daniel Sogg, *Wine Spectator* (USA)
4 Nov 04	P.W. Godden	*Brettanomyces*	Jeni Port, *The Age*
12 Nov 04	P.W. Godden	Screwcaps	Christian Davis, *Harpers* (United Kingdom)
12 Nov 04	P.W. Godden	Screwcaps	Terry Dunleavy, *New Zealand Wine Grower*
28 Nov 04	C.S. Stockley	Resveratrol component of wine	Leon Compton and Annie Gaston, ABC Radio Darwin
14 Dec 04	P.W. Godden	Closures	Daniel Sogg, *Wine Spectator* (USA)
17 Dec 04	P.W. Godden	Closures	Jo Burzynska, *Wine & Spirit International* and *Drinks Buyer Europe* (United Kingdom)
21 Dec 04	C.S. Stockley	Wine and health	Elisabeth King, *The Age*
23-Dec-04	P.W. Godden	Screwcaps and closures in general	Paul Tudor, Freelance (New Zealand), *Wine Business Monthly* (USA)
23 Dec 04	P.W. Godden	Screwcap availability and uptake in Australia and elsewhere	John Lewis, *Newcastle Herald*
04 Jan 05	P.W. Godden	Manipulating wine development by altering bottling conditions	Daniel Sogg, *Wine Spectator,* (USA) (Cover story published Vol 8, #17, March 2005)
04 Jan 05	P.W. Godden	Information for an article on screwcaps	Miriam Chastaingnt, *La Vigne* (France)
05-Jan-05	P.W. Godden	Closures	Paul Sellars, *The Weekly Times*, Melbourne
07 Jan 05	P.W. Godden	Clonal information on Nebbiolo and Trends in alcohol content of Australian wine	Tim White, *The Australian Financial Review*
10 Jan 05	P.W. Godden	Further information for an article on closures, particularly the reduction of bottled wine	Miriam Chastaingnt, *La Vigne* (France)
13 Jan 05	P.W. Godden	Closures review of Peter Godden's NZ Screwcap Initiative Conference paper	Tyson Stelzer, *Wine Press*
13 Jan 05	P.W. Godden	The oxygen permeation of closures	Samantha Caporn, *Wine International*
		The closure trial; oxygen permeation of closures	Paul Sellars, *Weekly Times*
20 Jan 50	P.W. Godden	Closures with reference to Peter Godden's NZ Screwcap Initiative Conference presentation	Jeannie Lee, Freelance (Hong Kong)
31 Jan 05	P.W. Godden	Oxygen permeation of closures	Kim Gordon, Beverage Daily.com
1 Mar 05	P.W. Godden	Statistics/trend of red wine production	Kate McCarthy, Freelance
1 Mar 05	P.W. Godden	Reduction issues with reference to 'bottle sickness'	Tim White, *The Australian Financial Review*
6 Mar 05	P.W. Godden	Closures/screwcaps and general AWRI activities	Matthew Jukes, *Daily Mail* (United Kingdom)
14 Mar 05	P.W. Godden	Information on closure trial	Patricia Briel, *Le Temps* (Switzerland)

Date	Staff member	Discussed	Media
15 Mar 05	P.W. Godden	Cork-related taints other than TCA, and issues related to re-corking old wines	Jamie Goode, Freelance, Harpers and Mitchell Beazley (United Kingdom)
31 Mar 05	P.W. Godden	Closures	Henry Work, *Practical Winery and Vineyard Management* (USA)
11 Apr 05	P.W. Godden	Importance of the closure in wine development post bottling and 'Mechanism of SO_2 as an anti-oxidant'	Jamie Goode, *Harpers* (United Kingdom)
23 Apr 05	P.W. Godden	Closures	Jamie Goode, *Harpers* (United Kingdom)
10 May 05	C.S. Stockley	The healthfulness of organic wines	Tony Love, *The Advertiser*
10 May 05	J.H. Swiegers	Yeast and wine aroma	Kathy Parker, ABC Adelaide
			Louise Maher, ABC Canberra
			Lynn Bell, ABC Melbourne
11 May 05	J.H. Swiegers	Yeast and wine aroma	Mike Welch, 2CC Radio, Canberra
12 May 05	P.W. Godden	Update information on closures, *Brettanomyces,* effects of yeast on wine flavour, origins of TCA, and mechanisms of oxygen permeation of corks	James Halliday, Freelance Mitchell Beazley *Art and Science of Wine*

Appendix 6 – AWRI internal committees

Staff member	Executive Management Group	Research Steering	Industry Services Steering	Communication Steering	Analytical Service Steering	Information Technology	Biosafety	Safety Advisory Committee	Staff Code Negotiation
E.J. Bartowsky						X		X/C**	X
S.-J. Bell		X	X	X	X				
R.J. Blair	X			C					
D.L. Capone									X
P.J. Chambers		X					X		
C.G. Daniel				X					
R.L. Edwards						X			
J.M. Eglinton						C			
P.C.H. Eichinger	X				X		X		
I.L. Francis		X							
M. Gishen		X	X		C				
P.W. Godden	X	X	C	X	X				X
H. Gockowiak								X	X
Y. Hayasaka		X	X						
P.A. Henschke		X			X			C*	
M.J. Herderich	X	C							
H.E. Muhlack	X							X	
K.F. Pocock							X	X	
A.P. Pollnitz						X			X
I.S. Pretorius	C	X		X					X
M.A. Sefton		X							
G.K. Skouroumounis									
C.S. Stockley		X							
J.H. Swiegers							Secretary		
R.L. Taylor						X			
E.J. Waters		X							

*** Resigned February 2005; ** Chair of Safety Committee March 2005**

The staff of the Australian Wine Research Institute

Back Row
Yoji Hayasaka, Matthew Cream, Matt Holdstock, Daniel Cozzolino, Mango Parker, Paul Smith, Bob Dambergs, Tracey Siebert, Belinda Bramley, Helen Holt, Kate Lattey, David Boehm, Wies Cynkar, Narelle D'Costa, Danielle Leedham, Maria Mills, Heather Brooks, David Jeffrey, Jelena Jovanovic, Steve Smith, Sandra Lloyd-Davies, Mariola Kwiatkowski, Creina Stockley, Ella Robinson, Chris Curtin, Steve Van Sluyter, Adrian Coulter, Jean Macintyre, Gayle Baldock, Sally-Jean Bell, Mark Gishen, Sally Kollmann, Jeff Eglinton, Dimi Capone, Liz Waters

Down the Stairs - Left to Right
Mark Sefton, Kevin Pardon, Darek Kutyna, Jenny Bellon, Tina Tran, Anthony Marafioti, Anita Molina, Claudia Wood, Merran Smith, Paul Henschke, Cristian Varela, Jane McCarthy, Hentie Swiegers, Robyn Willmott, Randell Taylor, George Skouroumounis, Eveline Bartowsky, Rachel Brown, Danie Malherbe, Simon Schmidt, Rachel Edwards, Gordon Elsey, Ingrid Oats, Heather Donnell, Leigh Francis, Melissa Francis, Paul Chambers, Catherine Daniel, Carol Sigston, June Robinson, Holger Gockowiak, Ken Pocock, Rhonda Milde, Caroline Sarneckis

Front Row
Rae Blair, Shiralee Dodd, Sakkie Pretorius, Hans Muhlack, Peter Godden, Markus Herderich

Absent
Renee Parsons, Jeanette Tooley, Pauline Jorgensen, Geoff Cowey, Peter Eichinger, Maria Birse, Stella Kassara, Katryna Van Leeuwen, Daniel Tynan, Slavko Bekavac.

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